DEKRA Testing and Certification, S.A.U.
Parque Tecnológico de Andalucía,
c/ Severo Ochoa nº 2 · 29590 Campanillas · Málaga · España
C.I.F. A29 507 456

DEKRA

ilac-MRA ENAC ENSAYOS Nº 51/LE147

Test report No:
NIE: 57478RRF.014A1

Test report
REFERENCE STANDARD: USA FCC Part 90

(*) Identification of item tested	Secure Smartphone
(*) Trademark	Bittium
(*) Model and /or type reference	Tough Mobile 2
Other identification of the product	HW Version: 0302 SW Version: 40.1 FCC ID: V27SD-61 IC: 3282B-SD61
(*) Features	LTE • 3GPP Rel12 • FDD/TDD Cat13/5, • DL 400Mbit/s, • UL 75 Mbit/s UMTS/HSPA • 3GPP rel8, HSPA+, • DL 42 Mbit/s, • UL 5.76 Mbit/s GSM/GPRS/EDGE Complementary Radios • Wi-Fi 802.11 a/b/g/n/ac (2.4 and 5 GHz), 2 x 2 MIMO • BT 5.0 • NFC
Applicant	BITTIUM WIRELESS OY Ritaharjuntie 1, 90590 Oulu, Finland
Test method requested, standard	USA FCC Part 90 (10-1-18 Edition). ANSI C63.26-2015. ANSI/TIA-603-E: 2016. KDB 971168 D01 Power Meas License Digital Systems v03r01, April. 2018.
Summary	IN COMPLIANCE
Approved by (name / position & signature)	Jose Carlos Luque RF Lab. Supervisor 74841983Y JOSE CARLOS LUQUE (C:A29507456) Firmado digitalmente por 74841983Y JOSE CARLOS LUQUE (C:A29507456) Fecha: 2019.10.22 16:09:59 +02'00'

Date of issue	2019-10-22
Report template No	FDT08_22 (*) "Data provided by the client"

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Competences and guarantees

DEKRA Testing and Certification S.A.U. is a testing laboratory accredited by the National Accreditation Body (ENAC -Entidad Nacional de Acreditación), to perform the tests indicated in the Certificate No. 51/LE 147.

DEKRA Testing and Certification is a FCC-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

DEKRA Testing and Certification is an ISED-recognized accredited testing laboratory with appropriate scope of accreditation that include testing performed in this test report.

In order to assure the traceability to other national and international laboratories, DEKRA Testing and Certification S.A.U. has a calibration and maintenance program for its measurement equipment.

DEKRA Testing and Certification S.A.U. guarantees the reliability of the data presented in this report, which is the result of the measurements and the tests performed to the item under test on the date and under the conditions stated on the report and, it is based on the knowledge and technical facilities available at DEKRA Testing and Certification S.A.U. at the time of performance of the test.

DEKRA Testing and Certification S.A.U. is liable to the client for the maintenance of the confidentiality of all information related to the item under test and the results of the test.

The results presented in this Test Report apply only to the particular item under test established in this document. **IMPORTANT:** No parts of this report may be reproduced or quoted out of context, in any form or by any means, except in full, without the previous written permission of DEKRA Testing and Certification S.A.U.

General conditions

1. This report is only referred to the item that has undergone the test.
2. This report does not constitute or imply on its own an approval of the product by the Certification Bodies or competent Authorities.
3. This document is only valid if complete; no partial reproduction can be made without previous written permission of DEKRA Testing and Certification S.A.U.
4. This test report cannot be used partially or in full for publicity and/or promotional purposes without previous written permission of DEKRA Testing and Certification S.A.U. and the Accreditation Bodies.

Uncertainty

Uncertainty (factor k=2) was calculated according to the DEKRA Testing and Certification S.A.U. internal document PODT000.

Data provided by the client

The following data has been provided by the client:

1. Information relating to the description of the sample ("Identification of the item tested", "Trademark", "Model and/or type reference tested").

2. The sample of Tough Mobile 2 consists of a Secure Smartphone targeted for professional use where High Security is required.

DEKRA Testing and Certification S.A.U. declines any responsibility with respect to the information provided by the client and that may affect the validity of results.

Usage of samples

Samples undergoing test have been selected by: The client.

- Sample S/01 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
57478C/032	Secure Smartphone	Tough Mobile 2	---	2018-11-26
57478C/033	USB cable	---	---	2018-11-26
57478C/034	AC/DC power adapter	---	---	2018-11-26
57478C/039	Headphones	---	---	2018-11-26

Sample S/01 has undergone the following test(s): All radiated tests indicated in Appendix A.

- Sample S/02 is composed of the following elements:

Control Nº	Description	Model	Serial Nº	Date of reception
57478C/016	Secure Smartphone	Tough Mobile 2	---	2018-10-25

Sample S/02 has undergone the following test(s): All conducted tests indicated in Appendix A.

Test sample description

<table>
<tr><td rowspan="5">Ports…….. :</td><td rowspan="2">Port name and description</td><td colspan="5">Cable</td></tr>
<tr><td>Specified length [m]</td><td colspan="2">Attached during test</td><td colspan="2">Shielded</td></tr>
<tr><td>Not provided.</td><td></td><td colspan="2">☐</td><td colspan="2">☐</td></tr>
<tr><td>-</td><td></td><td colspan="2">☐</td><td colspan="2">☐</td></tr>
<tr><td>-</td><td></td><td colspan="2">☐</td><td colspan="2">☐</td></tr>
<tr><td></td><td>-</td><td></td><td colspan="2">☐</td><td colspan="2">☐</td></tr>
<tr><td>Supplementary information to the ports…….. :</td><td colspan="7">N/A</td></tr>
<tr><td rowspan="3">Rated power supply .....:</td><td colspan="2" rowspan="2">Voltage and Frequency</td><td colspan="5">Reference poles</td></tr>
<tr><td>L1</td><td>L2</td><td>L3</td><td>N</td><td>PE</td></tr>
<tr><td>☐</td><td>AC:</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td></tr>
<tr><td></td><td>☒</td><td colspan="6">DC: 3.6 – 4.35 Vdc.</td></tr>
</table>

	☐	DC:		
Rated Power .....:	Not provided			
Clock frequencies.....:	Not provided			
Other parameters .....:	FCC ID: V27SD-61 IC: 3282B-SD61			
Software version .....:	40.1			
Hardware version .....:	0302			
Dimensions in cm (L x W x D).....:	Not provided			
Mounting position .....:	☐	Table top equipment		
	☐	Wall/Ceiling mounted equipment		
	☐	Floor standing equipment		
	☒	Hand-held equipment		
	☐	Other:		
Modules/parts.....:	Module/parts of test item		Type	Manufacturer
	N/A			
Accessories (not part of the test item) .....:	Description		Type	Manufacturer
	N/A			
	N/A			
	N/A			
Documents as provided by the applicant.....:	Description		File name	Issue date
	-			
	-			
	-			

Identification of the client

BITTIUM WIRELESS OY
Ritaharjuntie 1, 90590 Oulu, Finland

Testing period and place

Test Location	DEKRA Testing and Certification S.A.U.
Date (start)	2018-12-03
Date (finish)	2019-02-27

Document history

Report number	Date	Description
57478RRF.014	2019-08-30	First release
57478RRF.014A1	2019-10-22	Second release. RF Output Power measurements were added on the modulation 16 QAM.

Environmental conditions

In the control chamber, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %

In the semianechoic chamber, the following limits were not exceeded during the test.

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 75 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

In the chamber for conducted measurements, the following limits were not exceeded during the test:

Temperature	Min. = 15 ºC Max. = 35 ºC
Relative humidity	Min. = 20 % Max. = 35 %
Air pressure	Min. = 860 mbar Max. = 1060 mbar

Remarks and comments

The tests have been performed by the technical personnel: Ignacio Cabra, José Alberto Aranda and Miguel Angel Torres.

Used instrumentation:

Conducted Measurements

		Last Calibration	Due Calibration
1.	Chamber HERAEUS VMT 04/35	2018/06	2020/06
2.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2018/05	2019/05
3.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2019/02	2020/02
4.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2018/04	2019/04
5.	Spectrum Analyzer PSA 3Hz-26.5 GHz AGILENT TECHNOLOGIES E4440A	2017/10	2019/10
6.	Spectrum Analyzer ROHDE AND SCHWARZ FSW50	2018/02	2020/02
7.	Signal Analyzer 20 Hz to 8 GHz ROHDE AND SCHWARZ FSQ8	2018/08	2020/08
8.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2017/07	2019/07
9.	DC Power Supply 40V/40A Rohde & Schwarz NGPE40	2018/02	2021/02

Radiated Measurements

		Last Calibration	Due Calibration
1.	Semianechoic Absorber Lined Chamber ETS LINDGREN FACT 3 200 STP	N.A.	N.A.
2.	Biconical/Log Antenna 30MHz - 6GHz ETS LINDGREN 3142E	2018/10	2021/10
3.	EMI Test Receiver R&S ESR7	2018/08	2020/08
4.	Signal and Spectrum Analyzer ROHDE AND SCHWARZ FSV40	2018/02	2020/02
5.	Broadband Horn antenna 1-18 GHz SCHWARZBECK MESS-ELEKTRONIK BBHA 9120 D	2018/01	2021/01
6.	Wideband Radio Communication Tester ROHDE AND SCHWARZ CMW500	2019/05	2020/05
7.	RF pre-amplifier 1-18 GHz Bonn Elektronik BLMA 0118-1M	2019/04	2020/04

Testing verdicts

Not applicable:	N/A
Pass:	P
Fail:	F
Not measured:	N/M

Summary

FCC PART 90 PARAGRAPH Requirement – Test case	Verdict	Remark
Clause 90.542 (a) (7): RF output power	P	
Clause 2.1047: Modulation characteristics	P	
Clause 90.213: Frequency stability	P	
Clause 2.1049: Occupied Bandwidth	P	
Clause 90.543 (e) (2) (3) & (5): Spurious emissions at antenna terminals	P	
Clause 90.543 (e) (2) (3) & (f): Radiated emissions	P	
Supplementary information and remarks: None.		

Appendix A: Test results for FCC PART 90

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TEST CONDITIONS

POWER SUPPLY (V):

Vn: 3.8 Vdc

Vmax: 4.2 Vdc

Vmin: 3.6 Vdc

Type of Power Supply: Rechargeable battery.

The subscripts ‘n’, ‘min’ and ‘max’ indicate voltage test conditions (nominal, minimum and maximum respectively), as declared by the applicant.

ANTENNA GAIN:

LOW Bands		ANTENNA TYPE
LTE B14	-4.7 dBi	Monopole

TEST FREQUENCIES:

LTE Band 14. QPSK, 16QAM MODULATIONS:

	Channel (Frequency, MHz)	
	BW = 5 MHz	BW = 10 MHz
Lowest	23305 (790.5)	N/A
Middle	N/A	23330 (793)
Highest	23355 (795.5)	N/A

RF Output Power

SPECIFICATION:

FCC §90.542 (a) (7):

> (a) (7) Portable stations (hand-held devices) transmitting in the 758-768 MHz band and the 788-798 MHz band are limited to 3 watts ERP.

METHOD:

The conducted RF output power measurements were made at the RF output terminals of the EUT using the power meter of the Universal Radio Communication tester R&S CMW500, selecting maximum transmission power of the EUT and different modes of modulation.

The maximum equivalent isotropically radiated power (e.i.r.p.) is calculated by adding the declared maximum antenna gain (dBi).

The maximum effective radiated power e.r.p. is calculated from the maximum equivalent isotropically radiated power (e.i.r.p.) by subtracting 2.15 dB:

E.R.P. = E.I.R.P. – 2.15 dB

TEST SETUP:

1. CONDUCTED AVERAGE POWER:

RESULTS:

1. AVERAGE POWER:

LTE Band 14:

LTE Band 14. QPSK MODULATION. Bandwidth = 5 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	-4.7	-4.7	-4.7
Measured maximum average power (dBm) at antenna port	23.87	24.05	24.14
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	19.17	19.35	19.44
Maximum effective radiated power E.R.P. (dBm)	17.02	17.20	17.29
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 24.

LTE Band 14. 16QAM MODULATION. Bandwidth = 5 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	-4.7	-4.7	-4.7
Measured maximum average power (dBm) at antenna port	23.66	24.2	23.93
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	18.96	19.5	19.23
Maximum effective radiated power E.R.P. (dBm)	16.81	17.35	17.08
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 1. RB Offset: 24.

LTE Band 14. QPSK MODULATION. Bandwidth = 10 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	N/A	-4.7	N/A
Measured maximum average power (dBm) at antenna port	N/A	24.04	N/A
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	N/A	19.34	N/A
Maximum effective radiated power E.R.P. (dBm)	N/A	17.19	N/A
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation QPSK. RB Size: 1. RB Offset: 49.

LTE Band 14. 16QAM MODULATION. Bandwidth = 10 MHz.

Channel	Lowest	Middle	Highest
Maximum declared antenna gain (dBi)	N/A	-4.7	N/A
Measured maximum average power (dBm) at antenna port	N/A	24.02	N/A
Maximum equivalent isotropically radiated power (E.I.R.P.) (dBm)	N/A	19.32	N/A
Maximum effective radiated power E.R.P. (dBm)	N/A	17.17	N/A
Measurement uncertainty (dB)	<±0.66		

Worst case AVERAGE POWER: Modulation 16QAM. RB Size: 1. RB Offset: 49.

Frequency Stability

SPECIFICATION:

FCC § 90.213: Frequency stability.

The applicant shall ensure frequency stability by showing that fL minus the frequency offset and fH plus the frequency offset shall be within the frequency range in which the equipment is designed to operate.

METHOD:

The frequency tolerance measurements over temperature variations were made over the temperature range of –30ºC to +50ºC. The EUT was placed inside a climatic chamber and the temperature was raised hourly in 10ºC steps from –30ºC up to +50ºC.
The supply voltage was varied between 85% and 115% of nominal voltage.

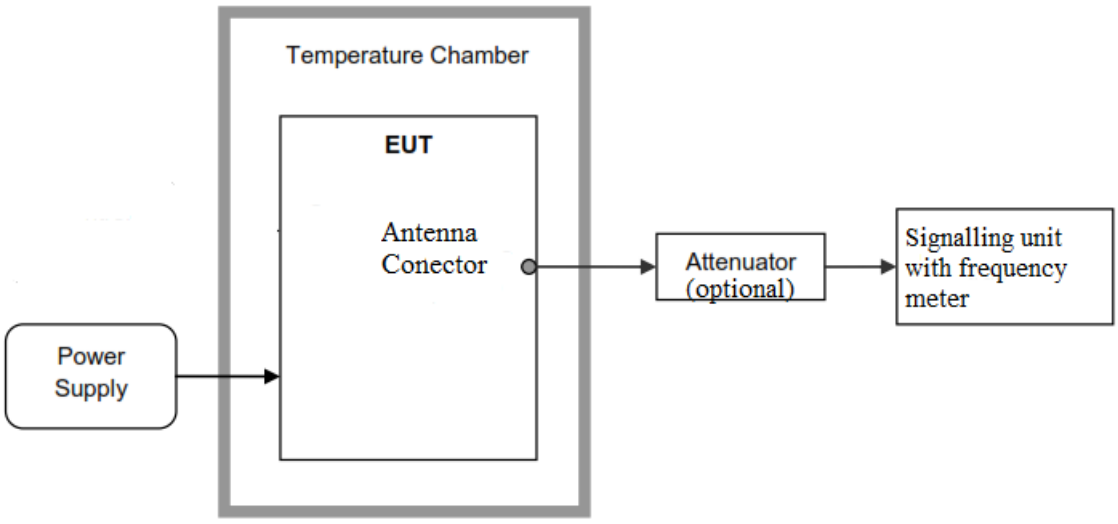
The EUT was set in “Radio Resource Control (RRC) mode” in the middle channel using the Universal Radio Communication tester R&S CMW500 and the maximum frequency error was measured using the built-in calibrated frequency meter.
The worst case LTE mode for conducted power was used for the test.

In order to check that the frequency stability is sufficient such that the fundamental emissions stay within the authorized bands of operation, a reference point is established at the applicable unwanted emissions limit using a RBW equal to the RBW required by the unwanted emissions specification of the applicable regulatory standard. These reference points measured using the lowest and highest channel of operation are identified as fL and fH respectively. The worst-case frequency offset determined in the above methods is added or subtracted from the values of fL and fH to check that the resulting frequencies remain within the band.

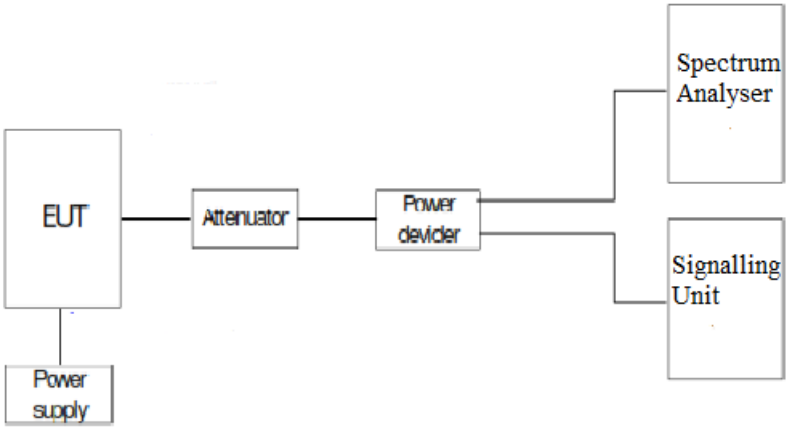
The reference point measurements were made at the RF output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation.

TEST SETUP:

1. Frequency Tolerance:



2. Reference Frequency Points fL and fH:



RESULTS:

1. Frequency Tolerance:

- **Frequency Stability over Temperature Variations:**

LTE Band 14. QPSK MODULATION. BW = 10 MHz.

Temperature (ºC)	Frequency Error (Hz)	Frequency Error (ppm)
+50	-2.03	-0.002559899
+40	-3.06	-0.003858764
+30	-5.75	-0.007250946
+20	-3.75	-0.004728878
+10	-3.09	-0.003896595
0	-1.97	-0.002484237
-10	-1.23	-0.001551072
-20	-2.76	-0.003480454
-30	-3.5	-0.004413619

- **Frequency Stability over Voltage Variations.**

LTE Band 14. QPSK MODULATION. BW = 10 MHz.

Battery Supply voltage	Voltage (V)	Frequency Error (Hz)	Frequency Error (ppm)
Vmax	4.2	-5.48	-0.006910467
Vmin(*)	3.6	-4.28	-0.005397226

(*): Operating end point specified by the manufacturer.

2. Reference Frequency Points fL and fH:

The worst-case frequency offsets added or subtracted per band and bandwidth:

LTE Band 14:

	LTE QPSK MODULATION. BW = 10 MHz
fL (MHz)	788.1819942500
fH (MHz)	797.8120012300

The reference frequency points fL and fH stay within the authorized blocks for all the bands above.

Verdict: PASS

Modulation Characteristics

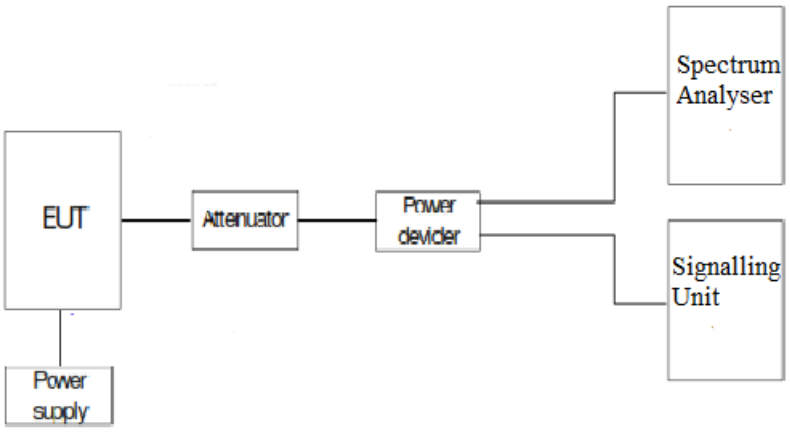
SPECIFICATION:

FCC §2.1047.

METHOD:

For LTE the EUT operates with QPSK and 16QAM modulation modes in which the information is digitised and coded into a bit stream. The RF transmission is multiplexed using *Orthogonal Frequency Division Multiplexing (OFDM)* using different possible arrangement of subcarriers (Resource Blocks RB).

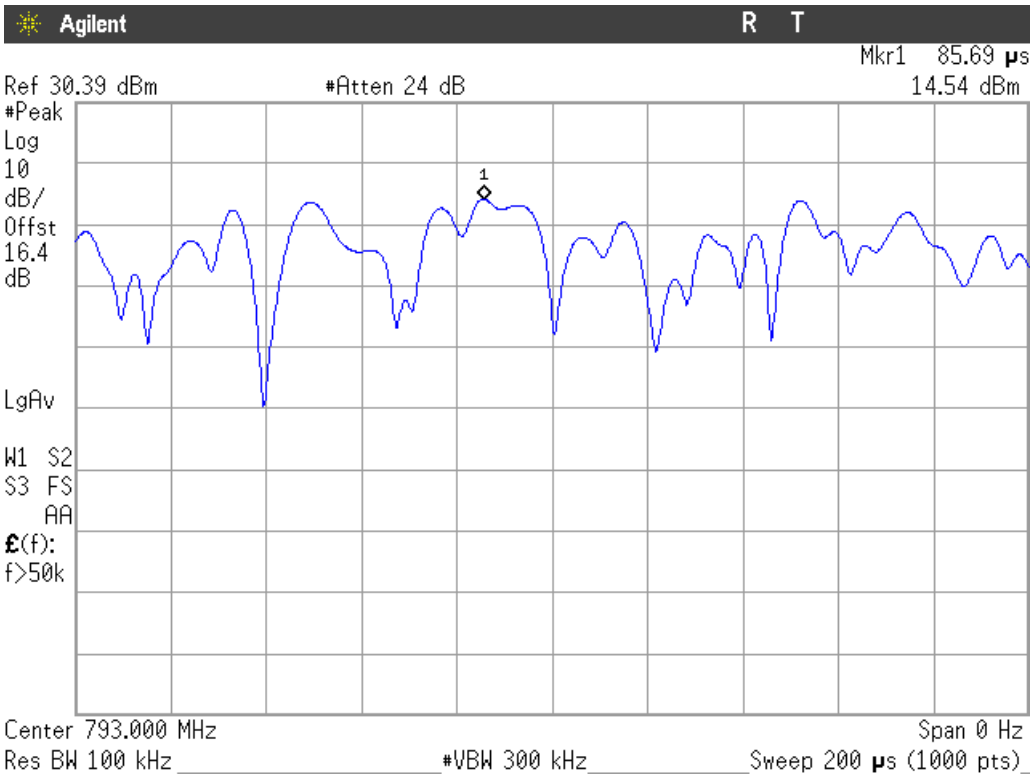
TEST SETUP:



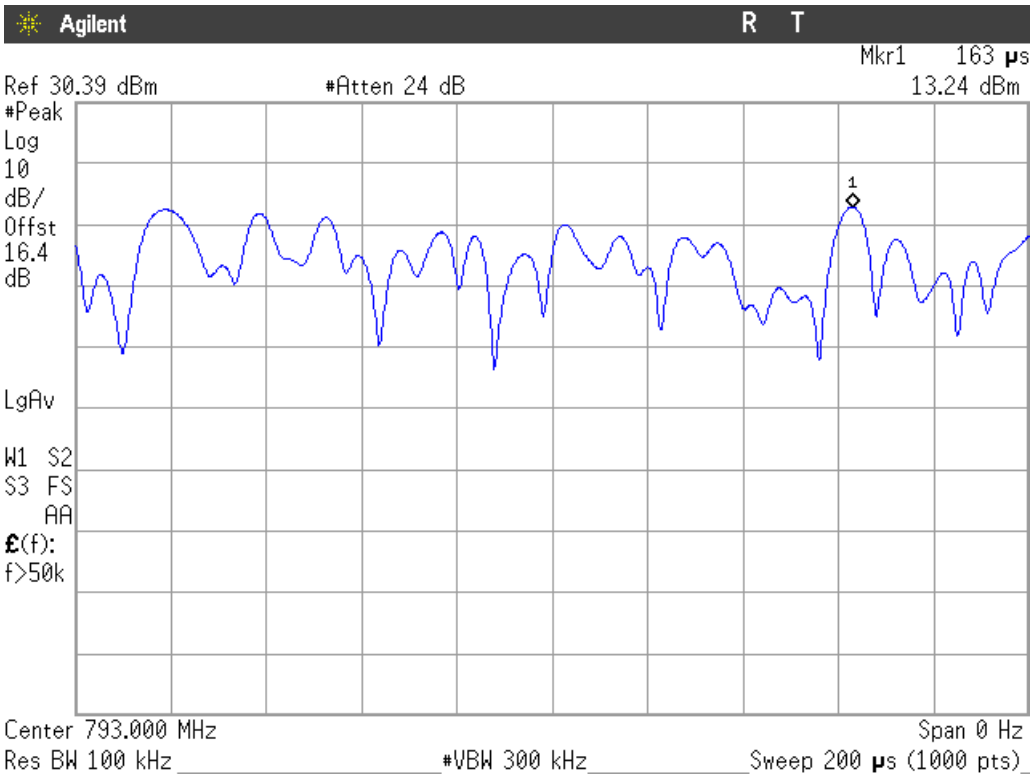
RESULTS:

The following plots show the modulation schemes in the EUT.

LTE Band 14. QPSK MODULATION. BW = 10 MHz.



LTE Band 14. 16QAM MODULATION. BW = 10 MHz.



Occupied Bandwidth

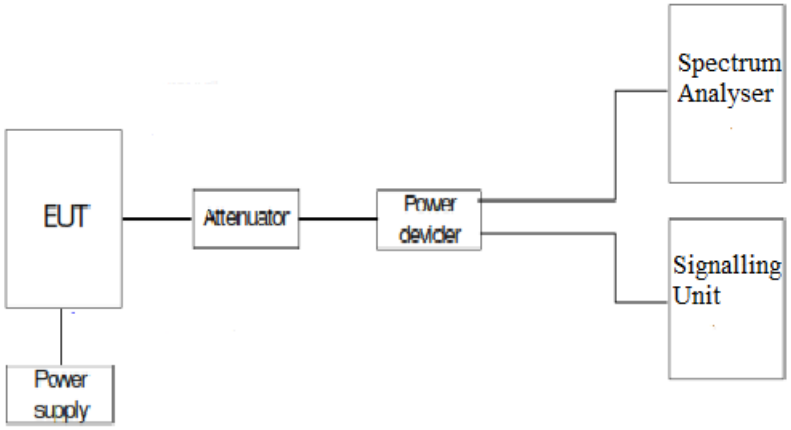
SPECIFICATION:

FCC §2.1049.

METHOD:

The occupied bandwidth measurement was performed at the output terminals of the EUT using an attenuator. power splitter and spectrum analyser. The EUT was controlled via the Universal Radio Communication tester R&S CMW500 selecting maximum transmission power of the EUT and different modes of modulation. The 99% occupied bandwidth and the -26 dBc bandwidth were measured directly using the built-in bandwidth measuring option of spectrum analyser.

TEST SETUP:



RESULTS:

LTE Bands: The worst case of Occupied Bandwidth corresponds to all Resource Blocks (RB) with Offset 0, regardless the nominal bandwidth selected.

LTE Band 14:

LTE Band 14. QPSK MODULATION. BW = 5 MHz.

	Lowest Channel	Middle Channel	Highest Channel
99% Occupied bandwidth (MHz)	4.5561	N/A	4.5140
-26 dBc bandwidth (MHz)	5.0230	N/A	4.9740
Measurement uncertainty (kHz)	<±16.67		

LTE Band 14. 16QAM MODULATION. BW = 5 MHz.

	Lowest Channel	Middle Channel	Highest Channel
99% Occupied bandwidth (MHz)	4.5211	N/A	4.5015
-26 dBc bandwidth (MHz)	4.9770	N/A	4.9890
Measurement uncertainty (kHz)	<±16.67		

LTE Band 14. QPSK MODULATION. BW = 10 MHz.

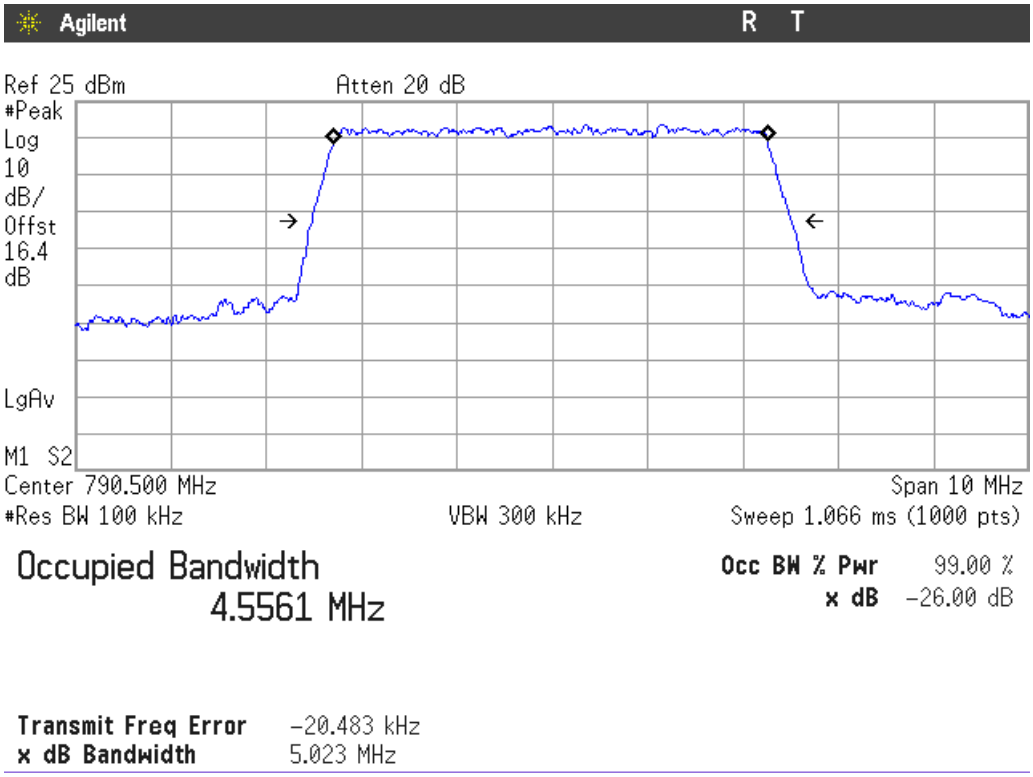
	Lowest Channel	Middle Channel	Highest Channel
99% Occupied bandwidth (MHz)	N/A	8.9461	N/A
-26 dBc bandwidth (MHz)	N/A	9.7330	N/A
Measurement uncertainty (kHz)	<±33.33		

LTE Band 14. 16QAM MODULATION. BW = 10 MHz.

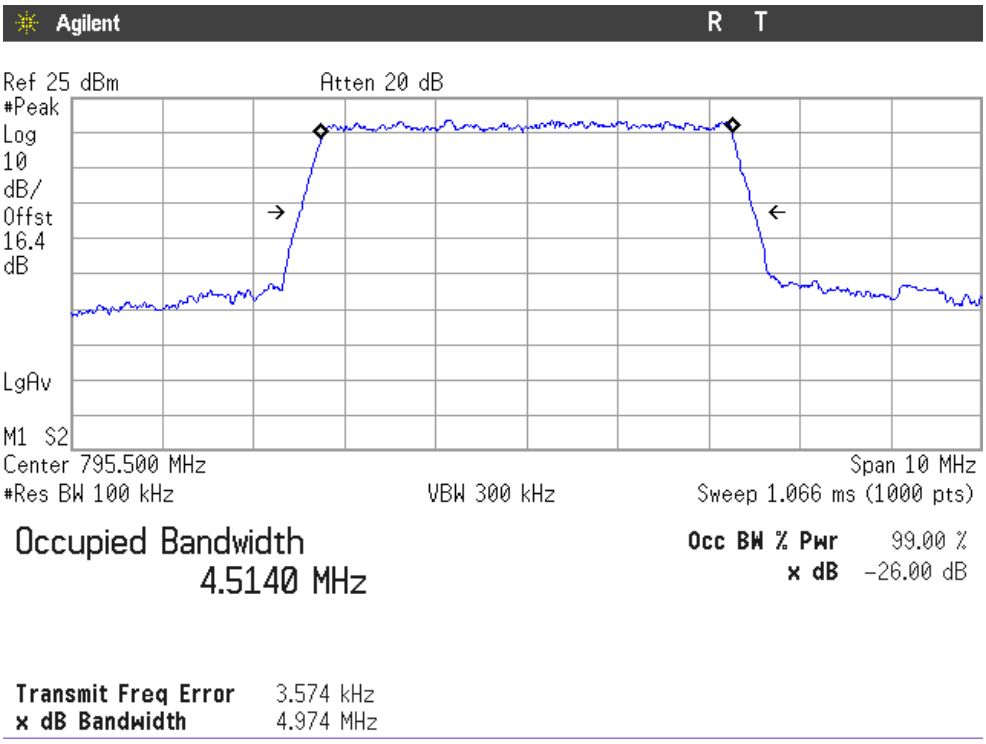
	Lowest Channel	Middle Channel	Highest Channel
99% Occupied bandwidth (MHz)	N/A	8.9585	N/A
-26 dBc bandwidth (MHz)	N/A	9.7210	N/A
Measurement uncertainty (kHz)	<±33.33		

LTE Band 14. QPSK MODULATION. BW = 5 MHz.

Lowest Channel:

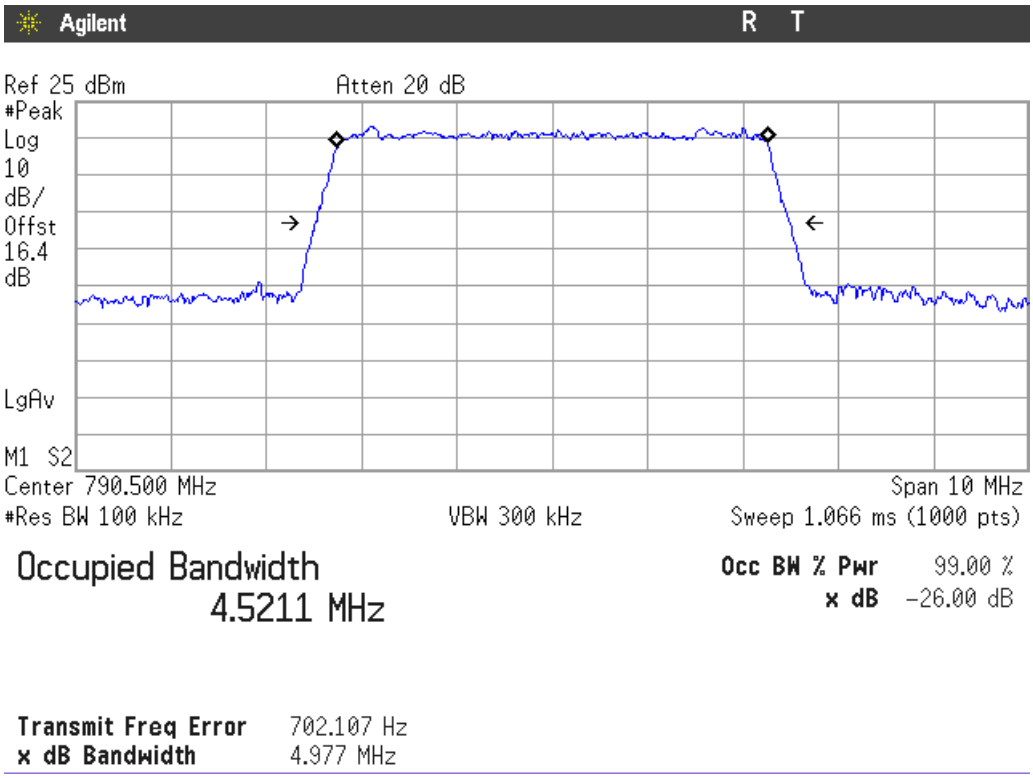


Highest Channel:

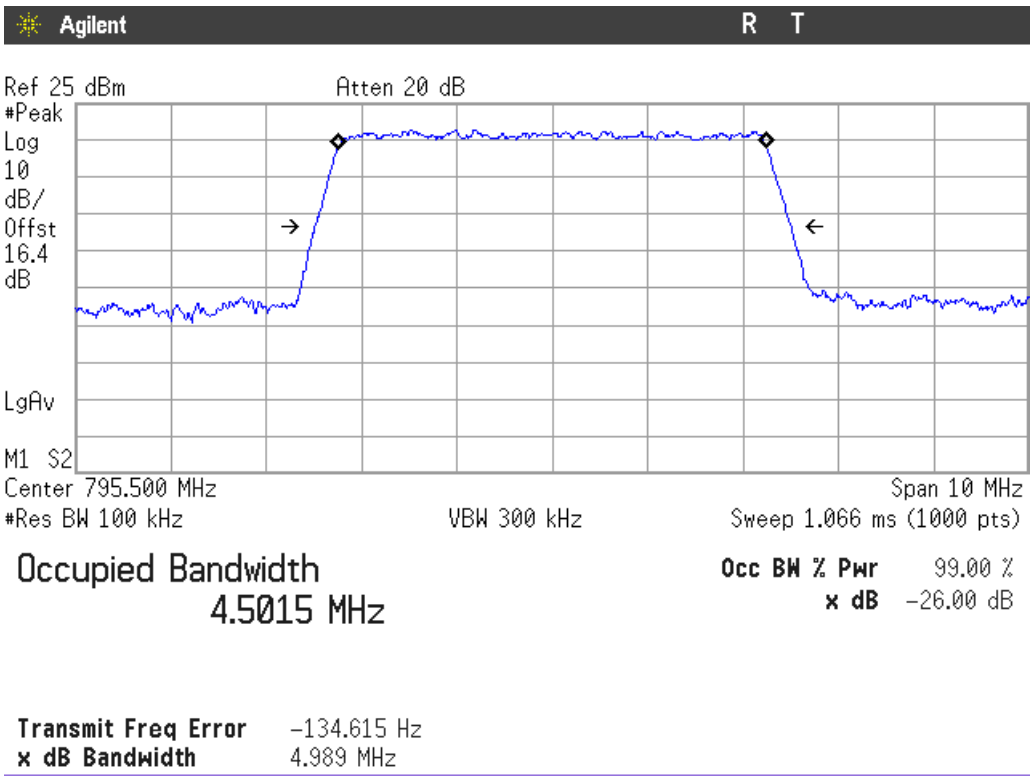


LTE Band 14. 16QAM MODULATION. BW = 5 MHz.

Lowest Channel:

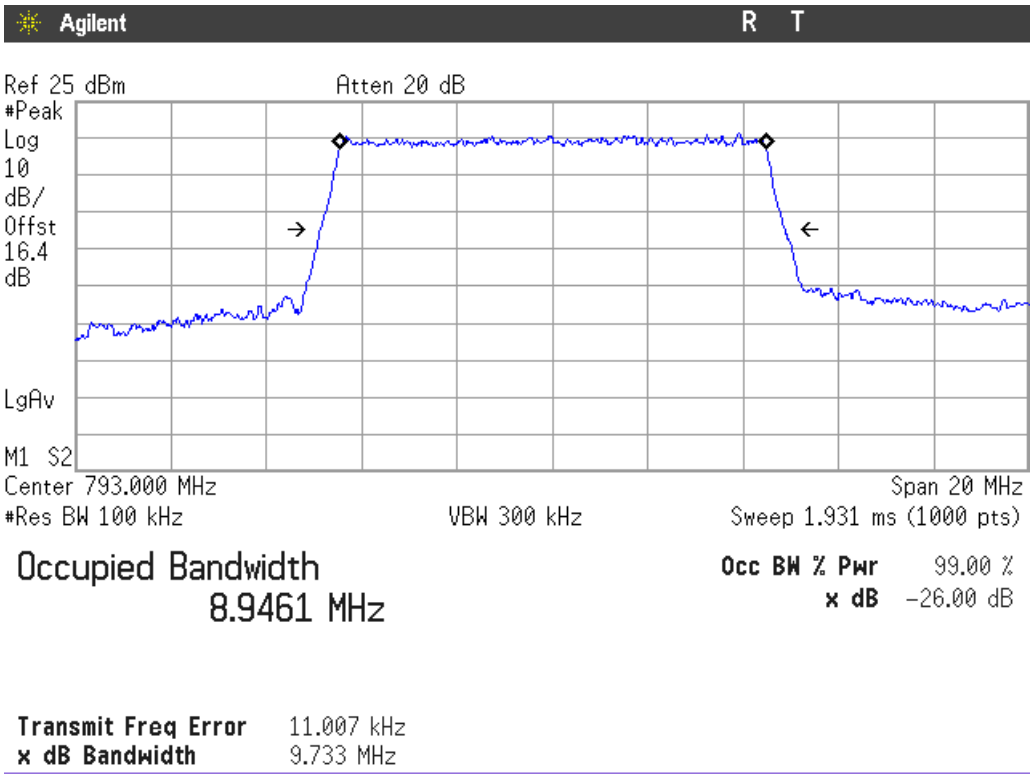


Highest Channel:



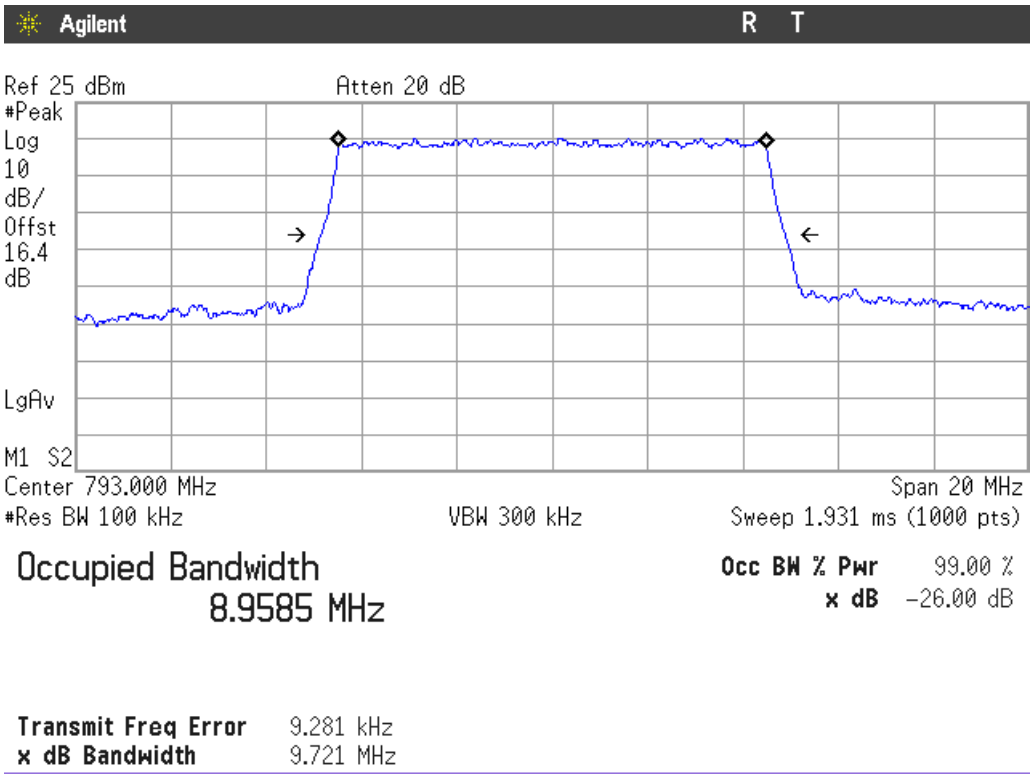
LTE Band 14. QPSK MODULATION. BW = 10 MHz.

Middle Channel:



LTE Band 14. 16QAM MODULATION. BW = 10 MHz.

Middle Channel:



Spurious emissions at antenna terminals

SPECIFICATION:

FCC §2.1051.

FCC §90.543 (e) (2) (3) (5) (&) (f):

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

METHOD:

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 Ohm attenuator and a power divider.
The spectrum was investigated from 9 kHz to 10th harmonic for LTE Band 14

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

The configuration of Resource Blocks and modulation which is the worst case for conducted power was used.

Measurement Limit:

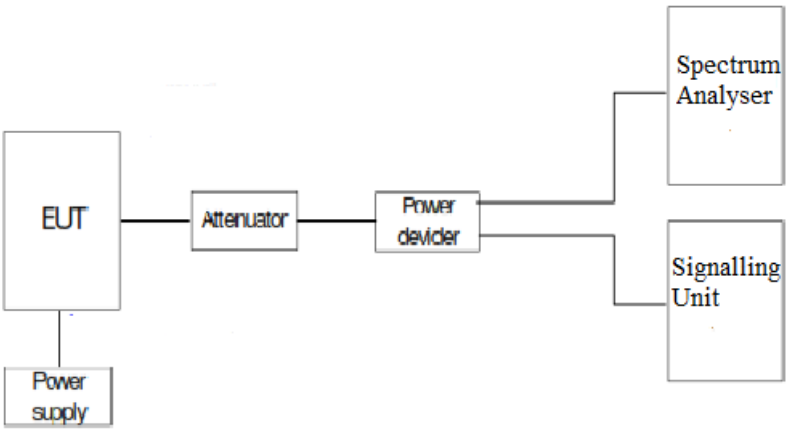
According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor not less 65 + 10 log (P) dB in a 6.25 kHz band segment. P in watts.
At Po transmitting power. the specified minimum attenuation becomes 65+10log (Po). and the level in dBm relative Po becomes:

Po (dBm) – [65 + 10 log (Po in mwatts) - 30] = - 35 dBm

According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least 43 + 10 log (P) dB. P in watts.
At Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

Po (dBm) – [43 + 10 log (Po in mwatts) - 30] = - 13 dBm

TEST SETUP:


EUT
Attenuator
Power devider
Spectrum Analyser
Signalling Unit
Power supply

RESULTS:

LTE BANDS: Test performed on the worst-case modulation and worst RB and worst Offset for all the nominal BW of each LTE band.

LTE Band 14. QPSK MODULATION. BW = 5 MHz.

Frequency range 9 KHz - 8 GHz:

- Lowest Channel:
No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:
No spurious frequencies detected at less than 20 dB below the limit in all the range.

Frequency range 769 - 775 MHz:

- Lowest Channel:
No spurious frequencies detected at less than 20 dB below the limit in all the range.

- Highest Channel:
No spurious frequencies detected at less than 20 dB below the limit in all the range.

Frequency range 799 - 805 MHz:

- Lowest Channel:
Spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Level (dBm)	Limit (dBm)	Measurement uncertainty (dB)
799.1736	-52.72	-35	< ± 2.03
801.3067	-50.04	-35	

- Highest Channel:
Spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Level (dBm)	Limit (dBm)	Measurement uncertainty (dB)
799.8036	-47.1	-35	< ± 2.03
802.0092	-45.28	-35	

Frequency range 1559 - 1610 MHz:

- Lowest Channel:
Spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Level (dBm)	Limit (dBm)	Measurement uncertainty (dB)
1585.381	-50.37	-40	< ± 2.03

- Highest Channel:
Spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Level (dBm)	Limit (dBm)	Measurement uncertainty (dB)
1595.418	-45.49	-40	< ± 2.03

LTE Band 14. QPSK MODULATION. BW = 10 MHz.

Frequency range 9 KHz - 8 GHz:

- Middle Channel:
No spurious frequencies detected at less than 20 dB below the limit.

Frequency range 769 - 775 MHz:

- Middle Channel:
No spurious frequencies detected at less than 20 dB below the limit.

Frequency range 799 - 805 MHz:

- Middle Channel:
Spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Level (dBm)	Limit (dBm)	Measurement uncertainty (dB)
801.8363	-40.15	-35	< ± 2.03

Frequency range 1559 - 1610 MHz:

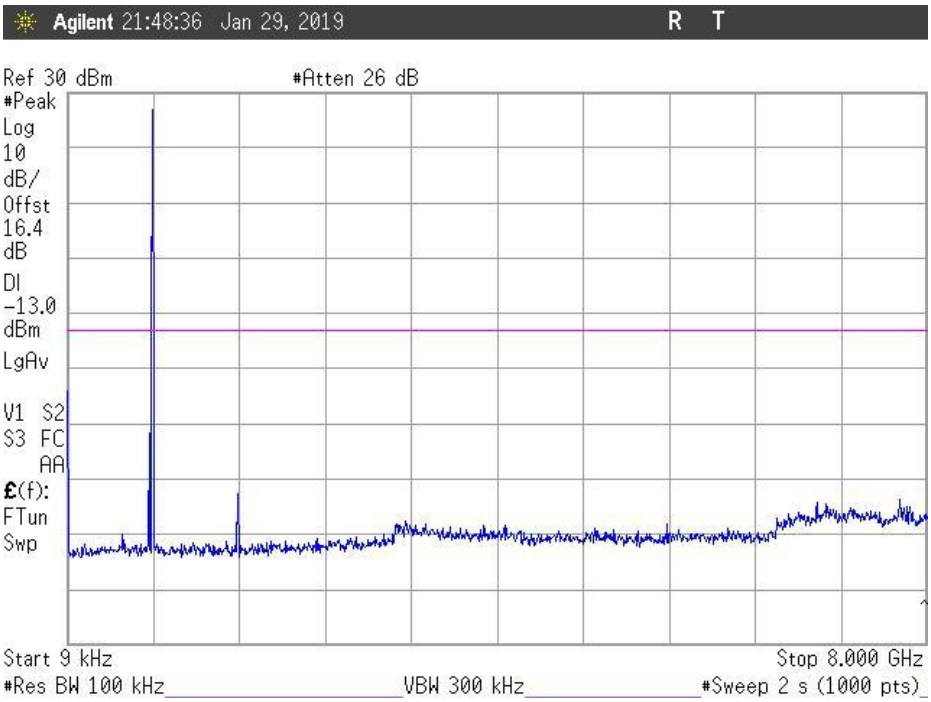
- Middle Channel:
Spurious frequencies detected at less than 20 dB below the limit:

Frequency (MHz)	Level (dBm)	Limit (dBm)	Measurement uncertainty (dB)
1594.895	-45.9	-40	< ± 2.03

LTE Band 14. QPSK MODULATION. BW = 5 MHz.

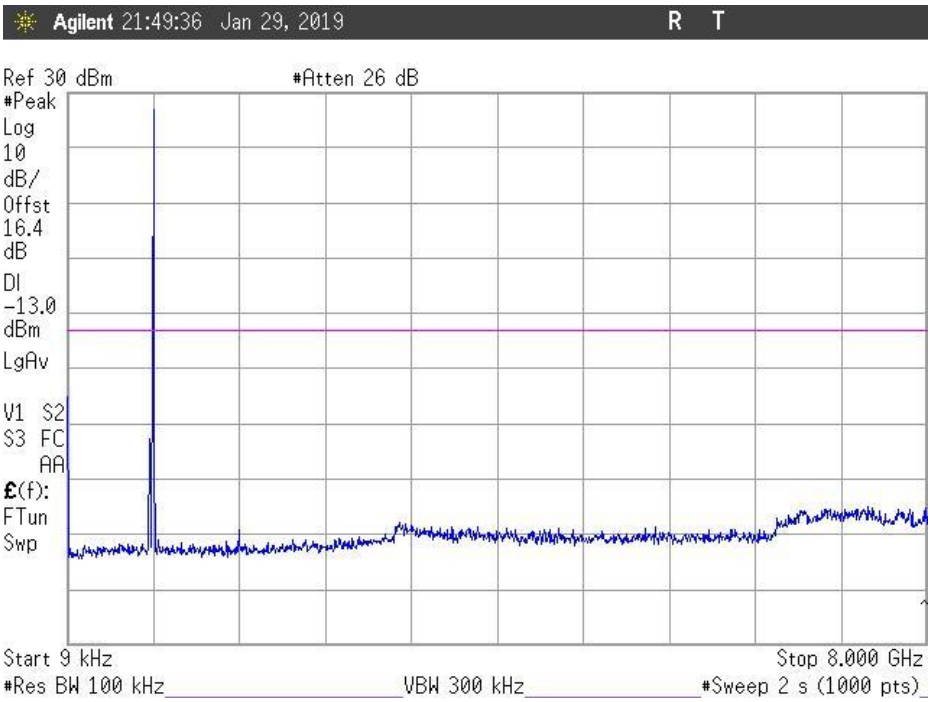
Frequency range 9 KHz - 8 GHz:

Lowest Channel:



The peak above the limit is the carrier frequency.

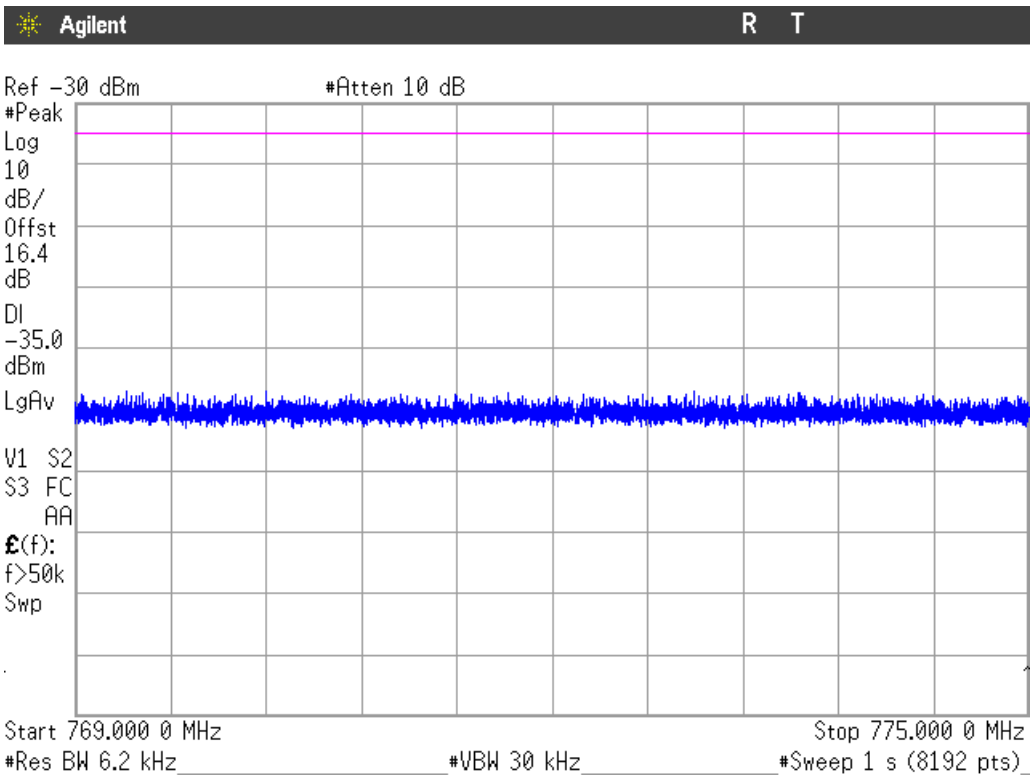
Highest Channel:



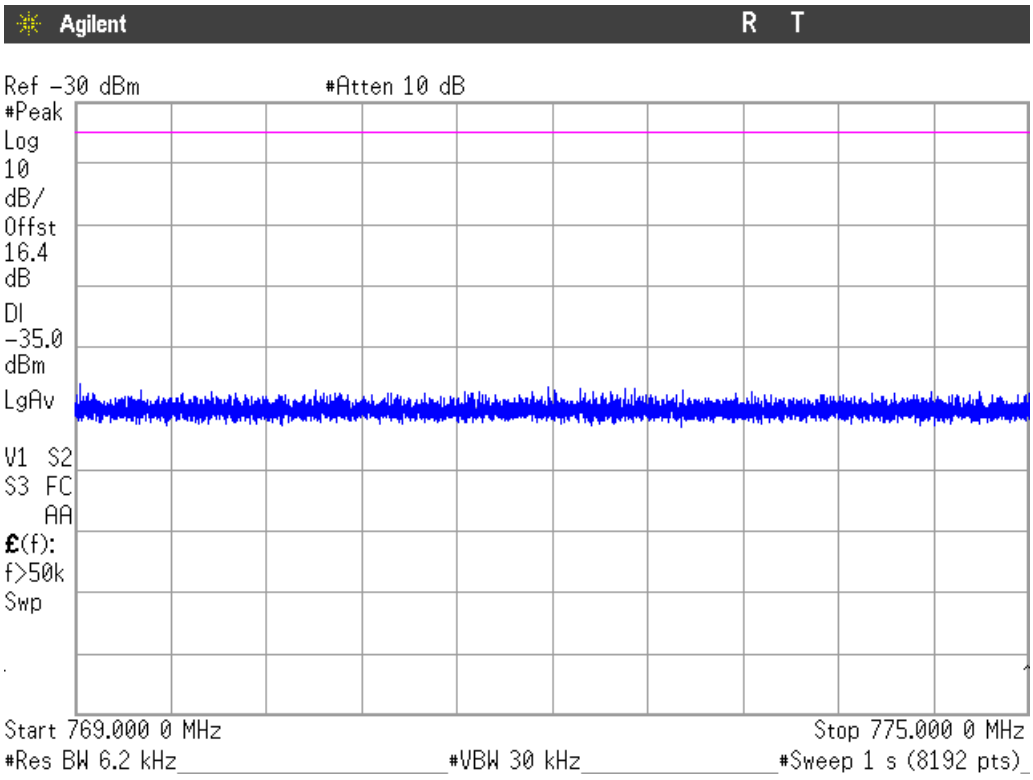
The peak above the limit is the carrier frequency.

Frequency range 769 - 775 MHz:

Lowest Channel:

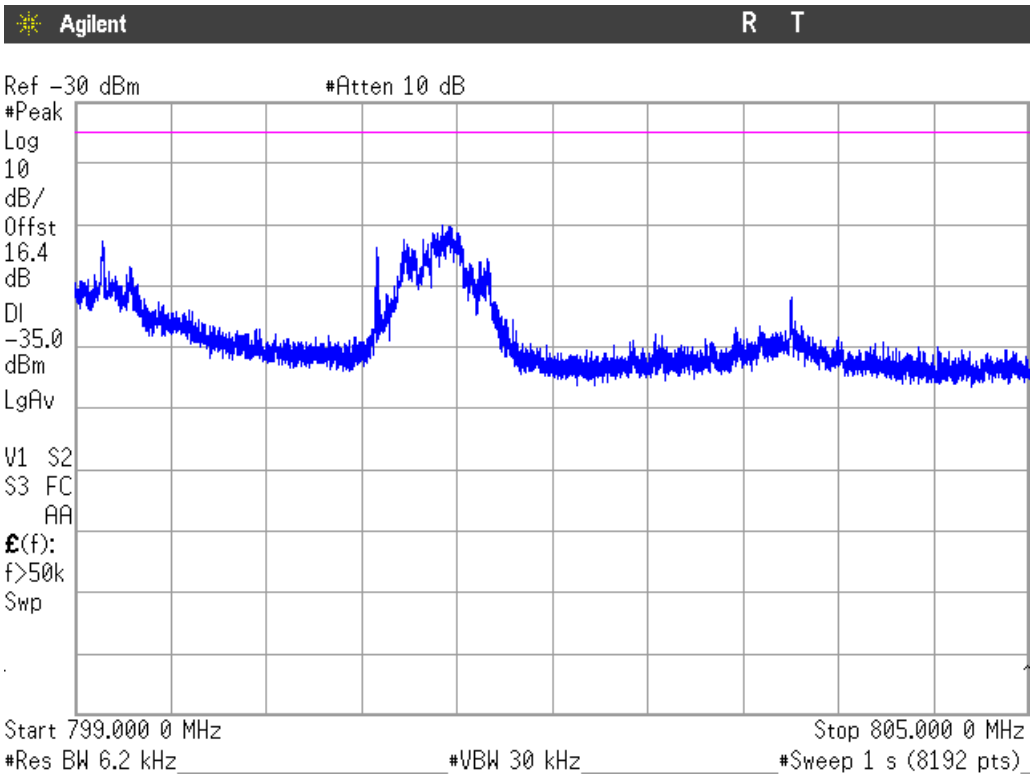


Highest Channel:

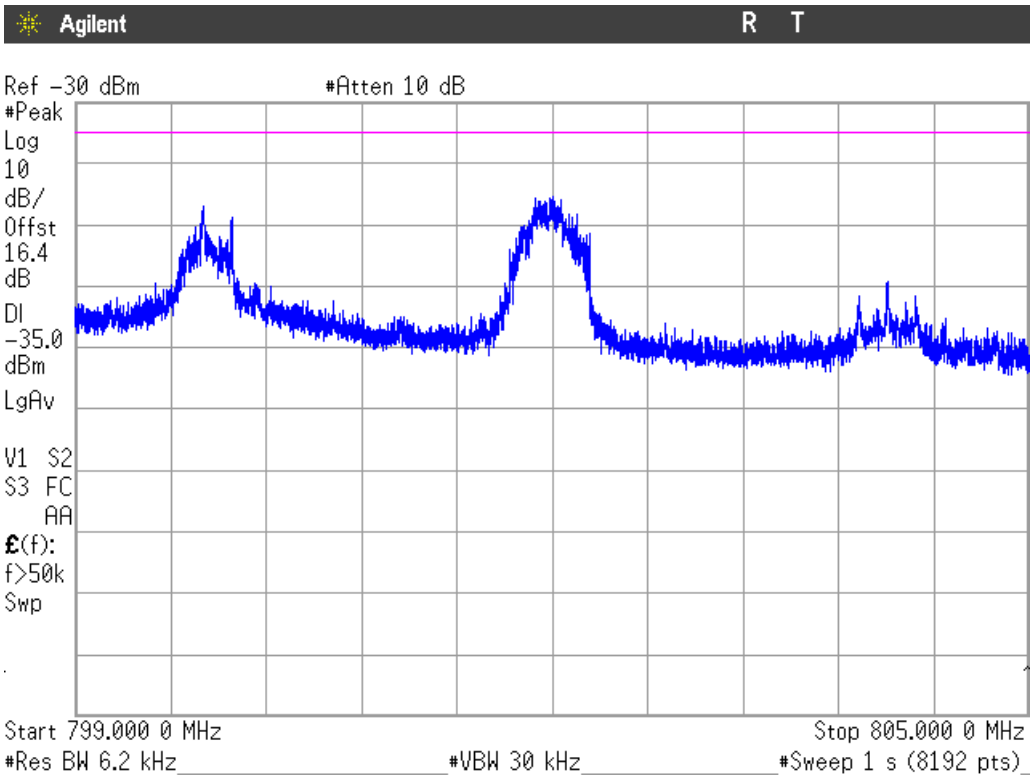


Frequency range 799 - 805 MHz:

Lowest Channel:

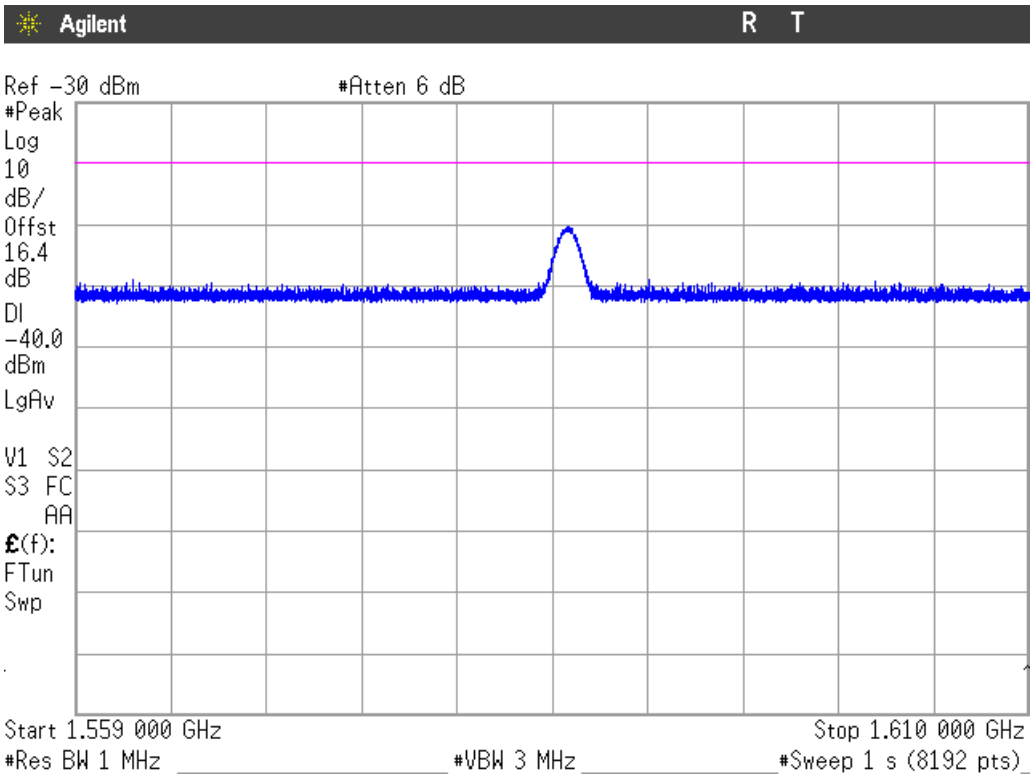


Highest Channel:

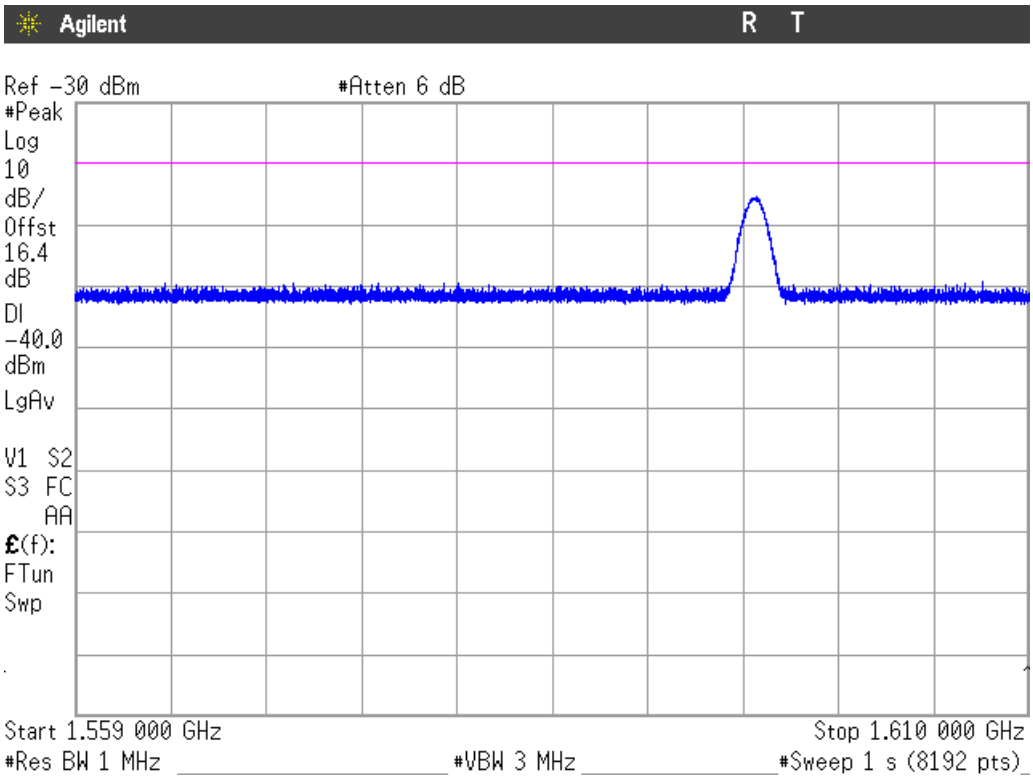


Frequency range 1559 - 1610 MHz:

Lowest Channel:



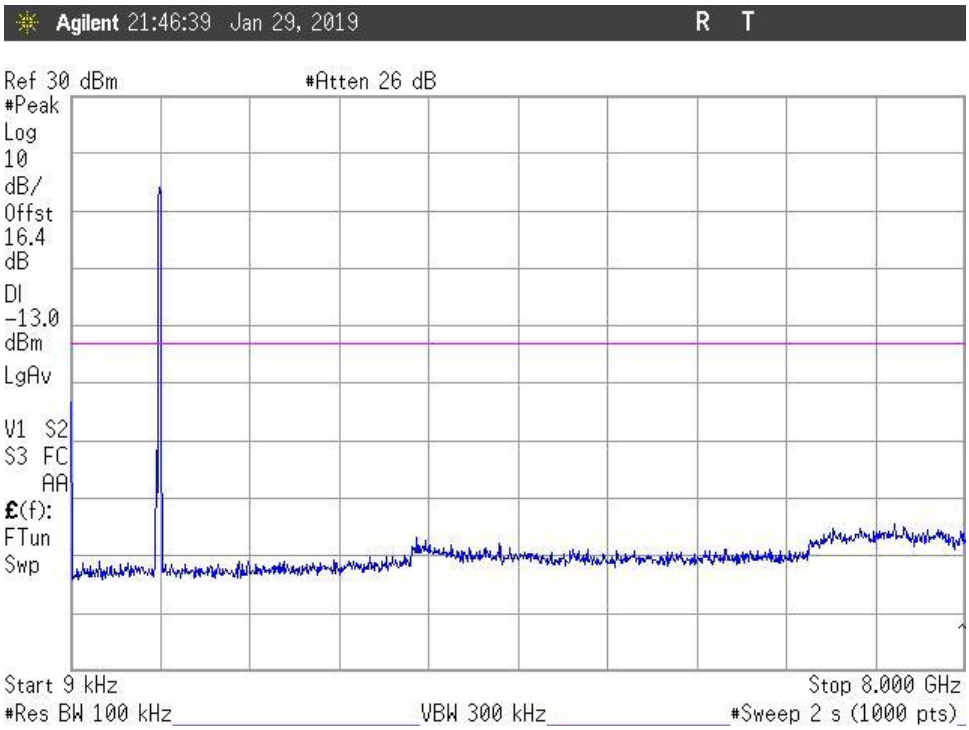
Highest Channel:



LTE Band 14. QPSK MODULATION. BW = 10 MHz.

Frequency range 9 KHz - 8 GHz:

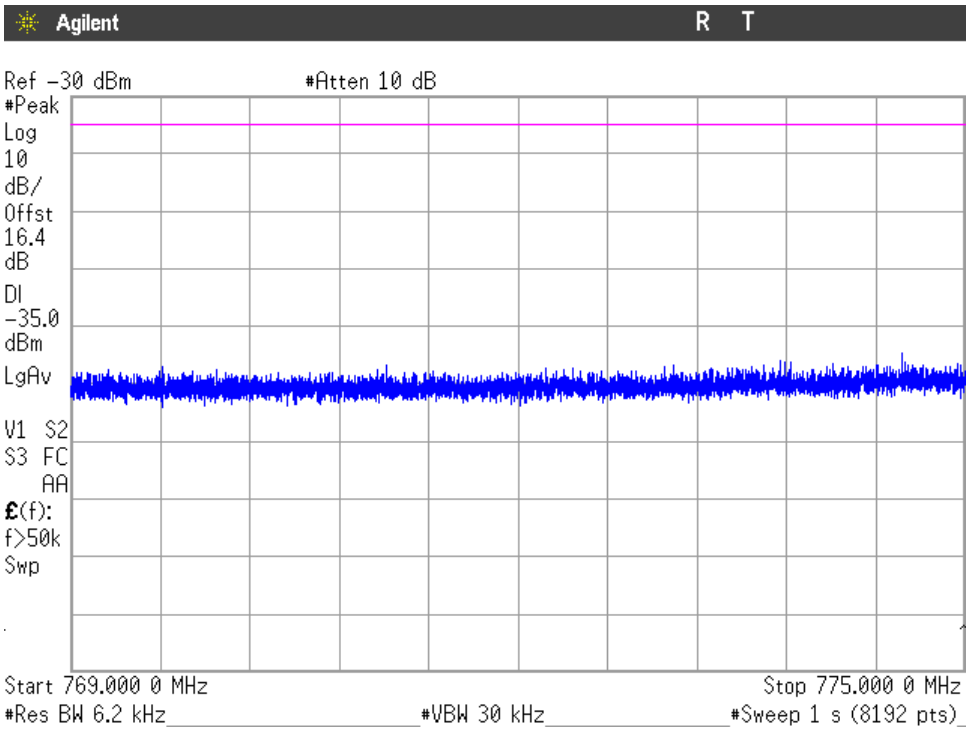
Middle Channel:



The peak above the limit is the carrier frequency.

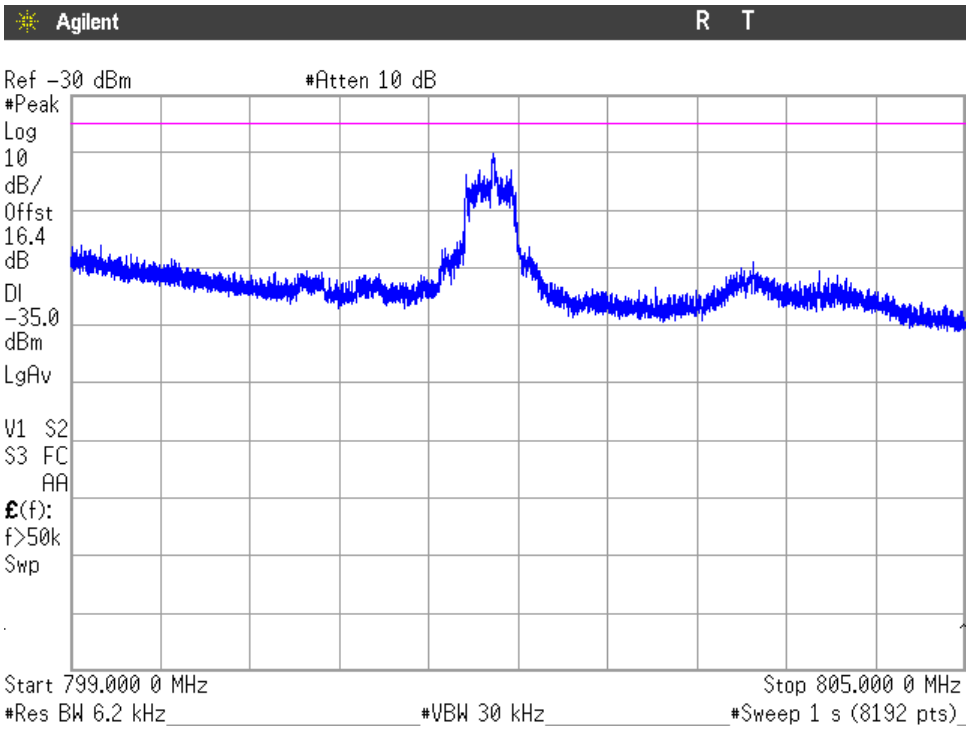
Frequency range 769 - 775 MHz:

Middle Channel:



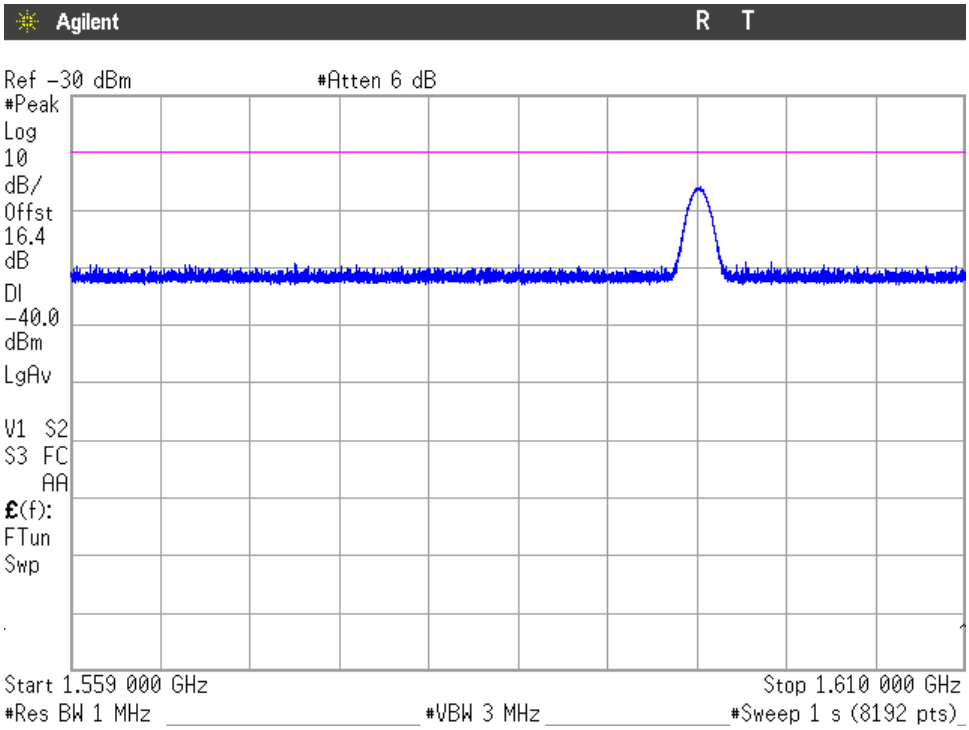
Frequency range 799 - 805 MHz:

Middle Channel:



Frequency range 1559 - 1610 MHz:

Middle Channel:



Spurious emissions at antenna terminals at Block Edges

SPECIFICATION:

FCC §2.1051.

FCC §90.543 (e)(3) & (5):

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

METHOD:

The EUT RF output connector was connected to a spectrum analyser and to the Universal Radio Communication tester R&S CMW500 (selecting maximum transmission power of the EUT and different modes of modulation) using a 50 Ohm attenuator and a power splitter.

The reading of the spectrum analyser is corrected with the attenuation loss of connection between output terminal of EUT and input of the spectrum analyser.

The configuration of modulation which is the worst case for conducted power was used.

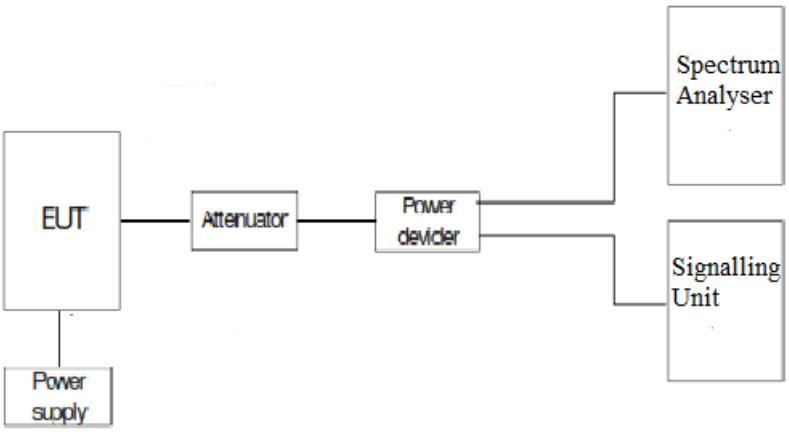
Measurement Limit:

According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least 43 + 10 log (P) dB. P in watts.

At Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

$$Po\ (dBm) – [43 + 10 \log (Po\ in\ mwatts) - 30] = - 13\ dBm$$

TEST SETUP:


Spectrum Analyser
EUT
Attenuator
Power devider
Signalling Unit
Power supply

RESULTS:

LTE Band 14.

LTE QPSK MODULATION:	RB=1, Offset=0, BW=5 MHz	RB=1 , Offset =0, BW = 10 MHz
Maximum measured level at Lowest Block Edge at antenna port (dBm)	-20.37	-33.5

LTE QPSK MODULATION:	RB=All, Offset=0, BW=5 MHz	RB=All, Offset=0, BW = 10 MHz
Maximum measured level at Lowest Block Edge at antenna port (dBm)	-23.78	-28.61

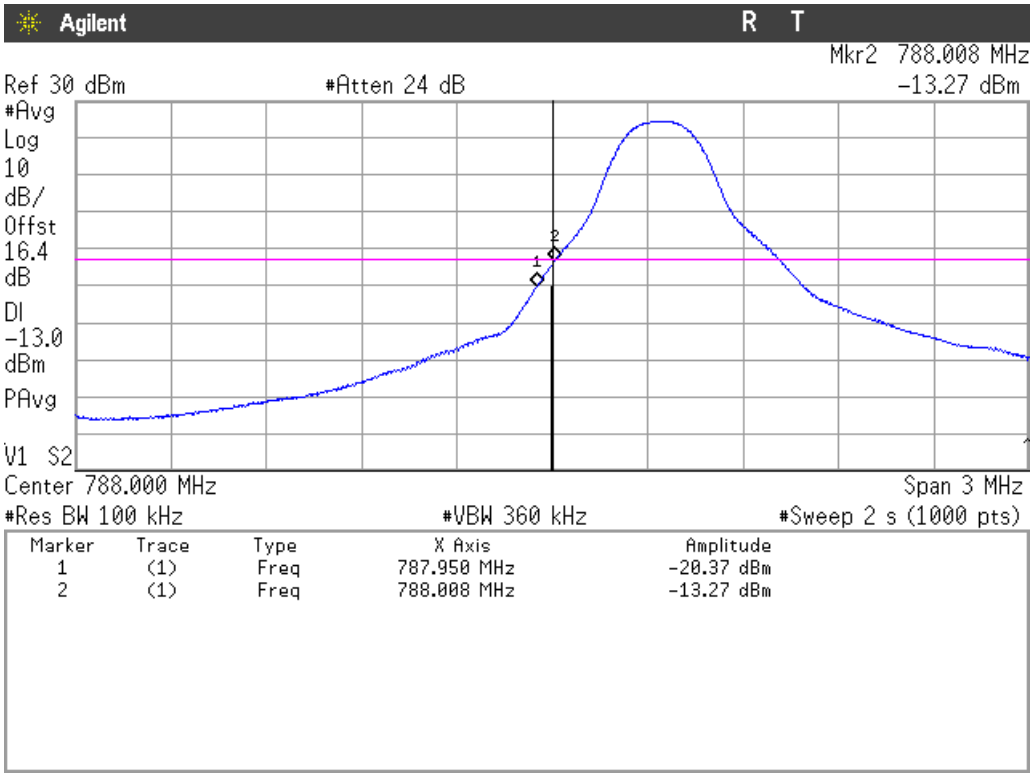
LTE QPSK MODULATION:	RB=1, Offset =Max, BW=5 MHz	RB=1 , Offset =Max, BW = 10 MHz
Maximum measured level at Highest Block Edge at antenna port (dBm)	-20.75	-33.17

LTE QPSK MODULATION:	RB=All, Offset=0, BW=5 MHz	RB=All, Offset=0, BW = 10 MHz
Maximum measured level at Highest Block Edge at antenna port (dBm)	-23.98	-26.68

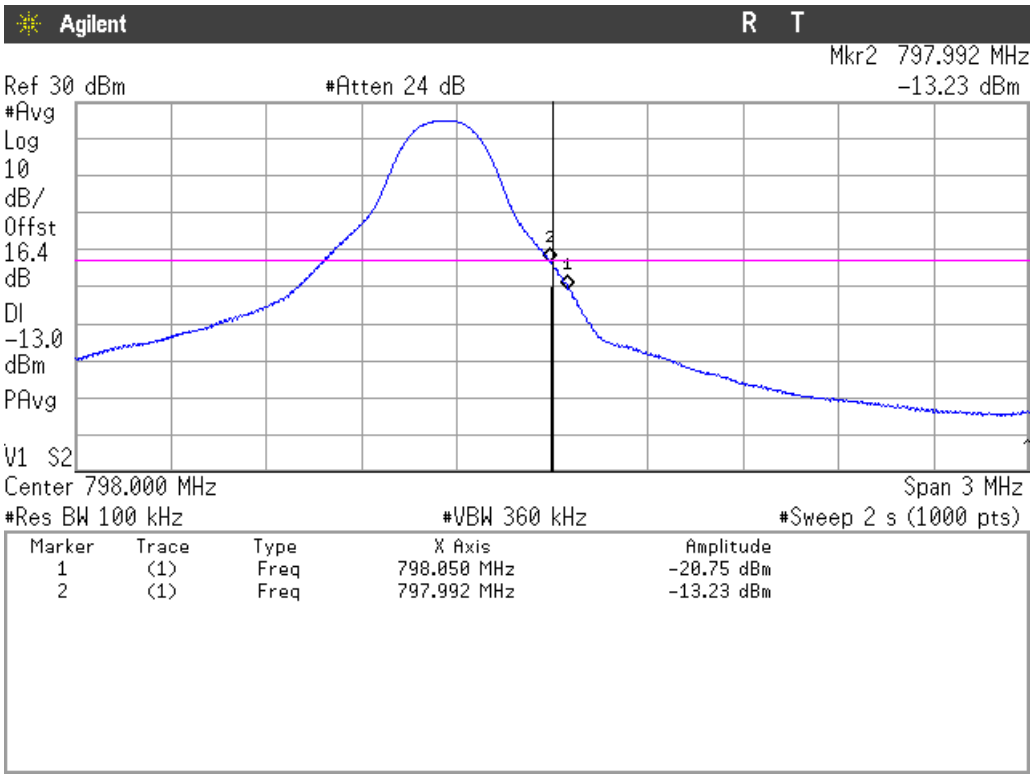
Measurement uncertainty: ≤±1.57 dB

Verdict: PASS

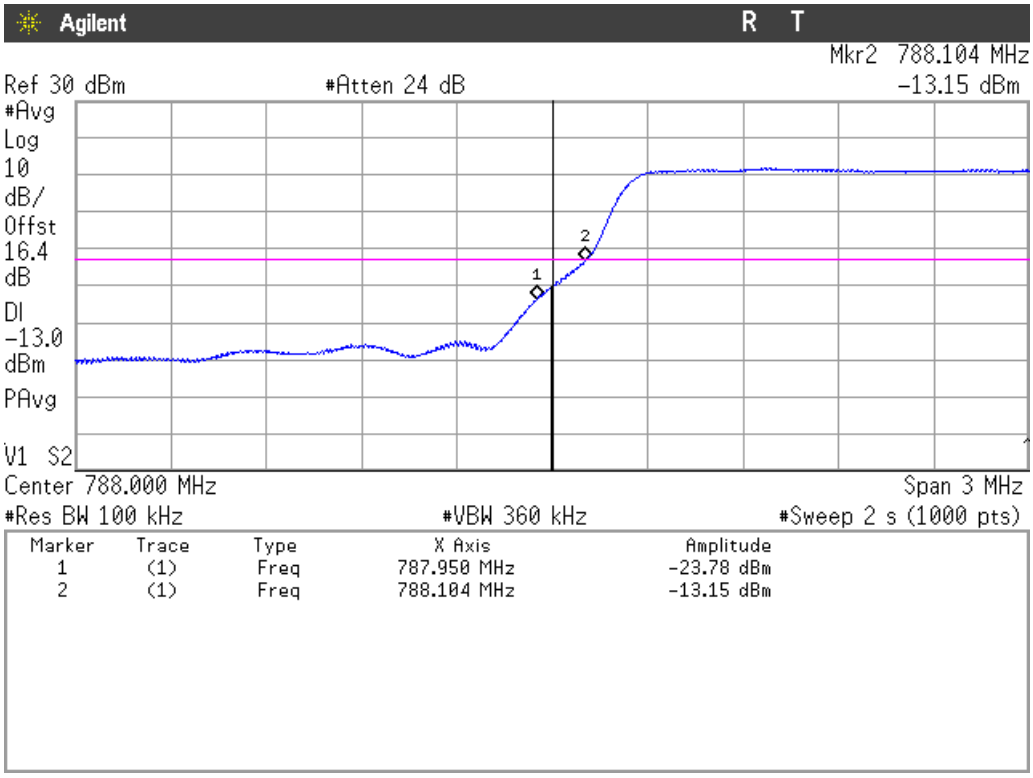
LTE Band 14. QPSK MODULATION. BW=5 MHz. RB=1. Offset=0. Lowest Block Edge:

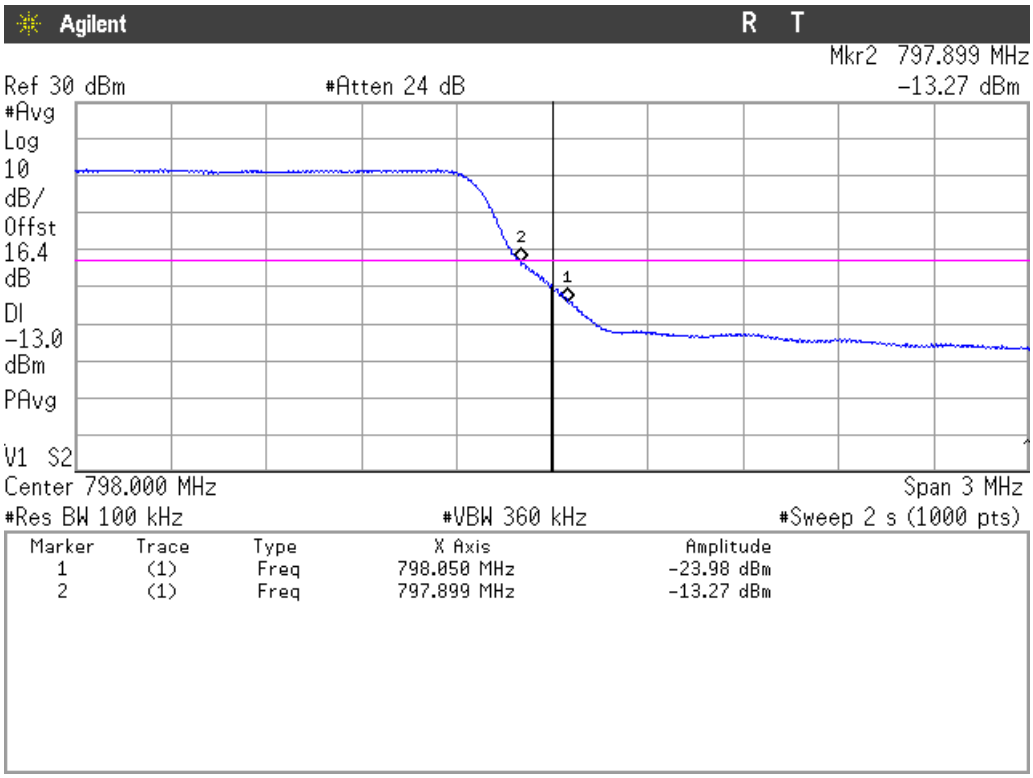


LTE Band 14. QPSK MODULATION. BW=5 MHz. RB=1. Offset=Max. Highest Block Edge:

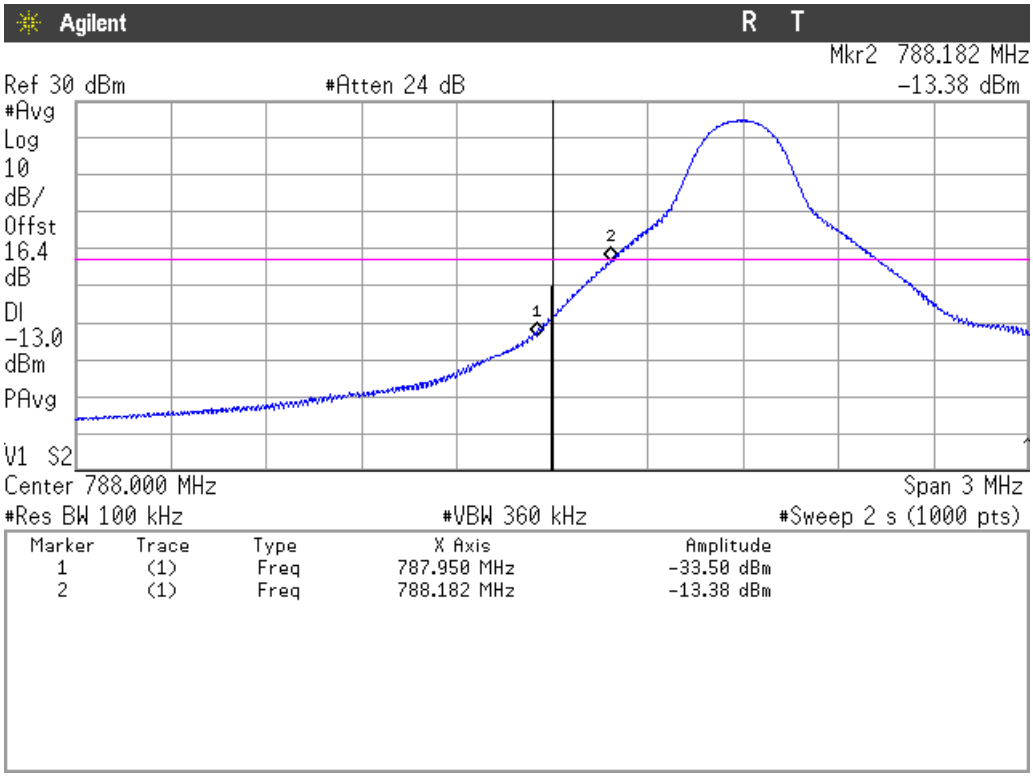


LTE Band 14. QPSK MODULATION. BW=5 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:

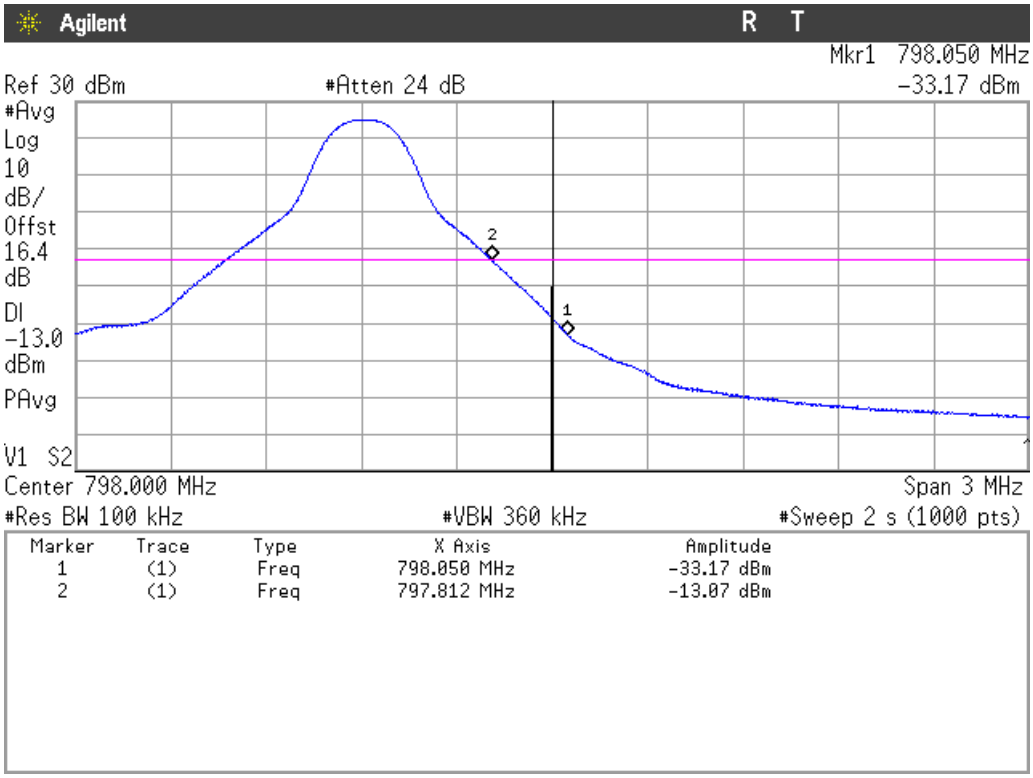




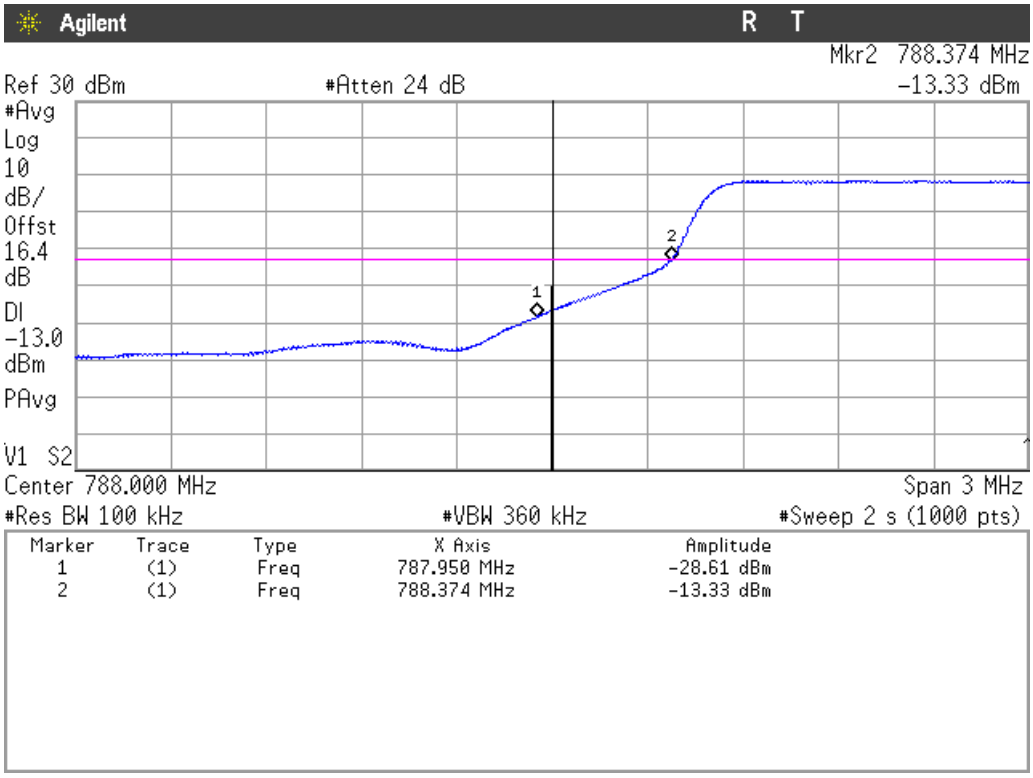
LTE Band 14. QPSK MODULATION. BW=10 MHz. RB=1. Offset=0. Lowest Block Edge:

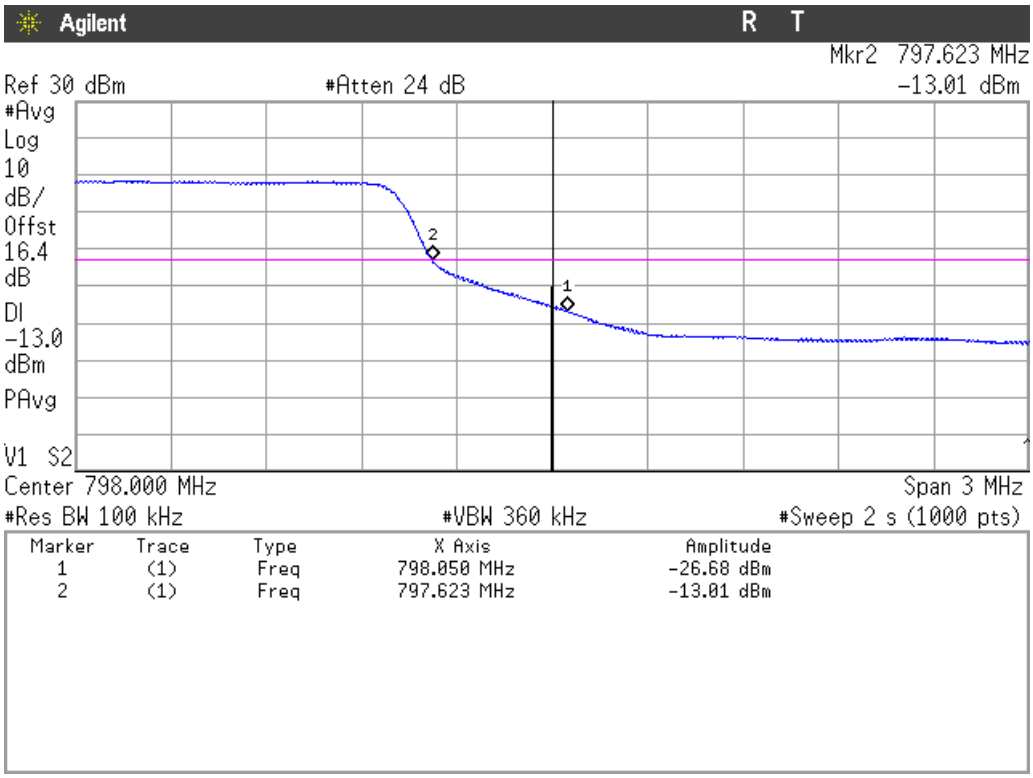


LTE Band 14. QPSK MODULATION. BW=10 MHz. RB=1. Offset=Max. Highest Block Edge:



LTE Band 14. QPSK MODULATION. BW=10 MHz. RB=All. Offset=0. Lowest and Highest Block Edges:





Radiated emissions

SPECIFICATION:

FCC §2.1051. Measurements required: Spurious emissions at antenna terminals.

FCC §90.543 (e) (2) (3) (5) & (f):

(e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:

(2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than 65 + 10 log (P) dB in a 6.25 kHz band segment, for mobile and portable stations.

(3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least 43 + 10 log (P) dB.

(5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.

(f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to −70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and −80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

METHOD:

The measurement was performed with the EUT inside an anechoic chamber.

The spectrum was scanned from 30 MHz to at least the 10th harmonic of the highest frequency generated within the equipment.

The EUT was placed on a non-conductive stand at a 3 meter distance from the measuring antenna for measurements below 1 GHz and at 1 m distance for measurements above 1 GHz.
Detected emissions were maximized at each frequency by rotating the EUT and adjusting the measuring antenna height and polarization. The maximum meter reading was recorded.

Each detected emission at less than 20 dB respect to the limit is substituted by the Substitution method in accordance with the ANSI/TIA-603-E: 2016.

Measurement Limit:

According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor not less 65 + 10 log (P) dB in a 6.25 kHz band segment. P in watts.
At Po transmitting power. the specified minimum attenuation becomes 65+10log (Po). and the level in dBm relative Po becomes:

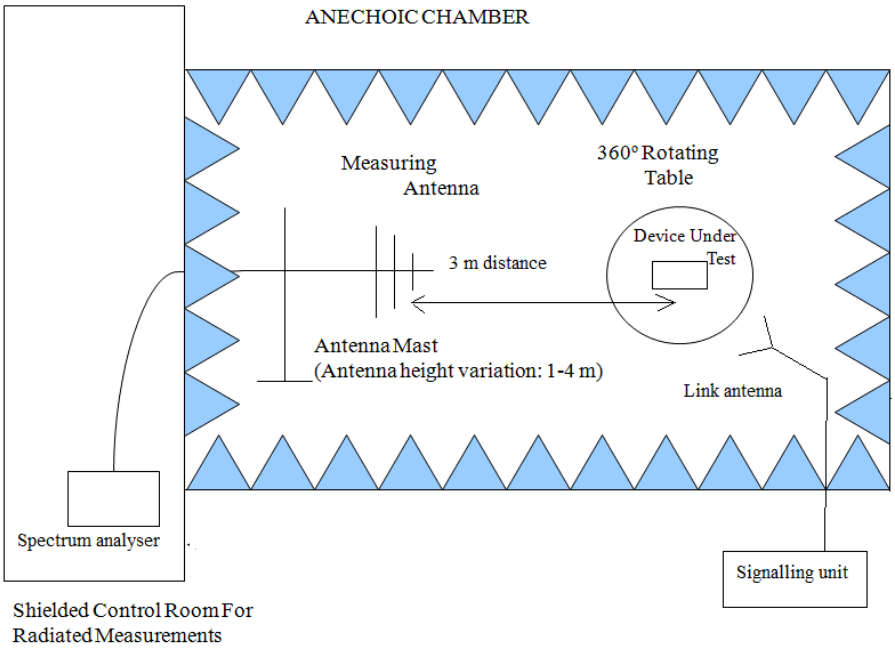
$$Po\ (dBm) – [65 + 10 \log (Po\ in\ mwatts) - 30] = - 35\ dBm$$

According to specification. the power of emissions shall be attenuated below the transmitter power (P) by a factor of at least 43 + 10 log (P) dB. P in watts.
At Po transmitting power. the specified minimum attenuation becomes 43+10log (Po). and the level in dBm relative Po becomes:

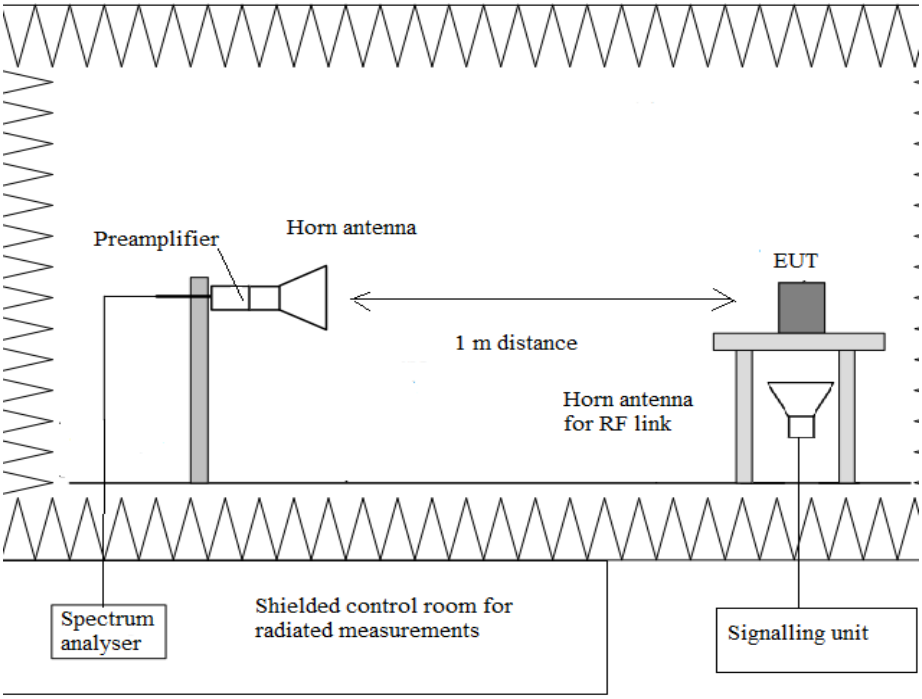
$$Po\ (dBm) – [43 + 10 \log (Po\ in\ mwatts) - 30] = - 13\ dBm$$

TEST SETUP:

Radiated measurements below 1 GHz.



Radiated measurements above 1 GHz.



RESULTS:

LTE Band 14:

QPSK and 16QAM Modulations:
A preliminary scan determined the QPSK modulation, BW=5 MHz, RB=1, Offset=24 as the worst case.

- Lowest Channel:

Frequency range 30 MHz - 1 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 769-775 MHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 799-805 MHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 8 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1559 – 1610 MHz

Spurious frequencies at less than 20 dB below the limit:

Frequency (GHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1.5853067	-35.73	V	-48.64	0.80	8.14	-41.30

- Highest Channel:

Frequency range 30 MHz - 1 GHz

Spurious frequencies at less than 20 dB below the limit:

Frequency range 769-775 MHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 799-805 MHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1 - 8 GHz

No spurious frequencies at less than 20 dB below the limit.

Frequency range 1559 – 1610 MHz

Spurious frequencies at less than 20 dB below the limit:

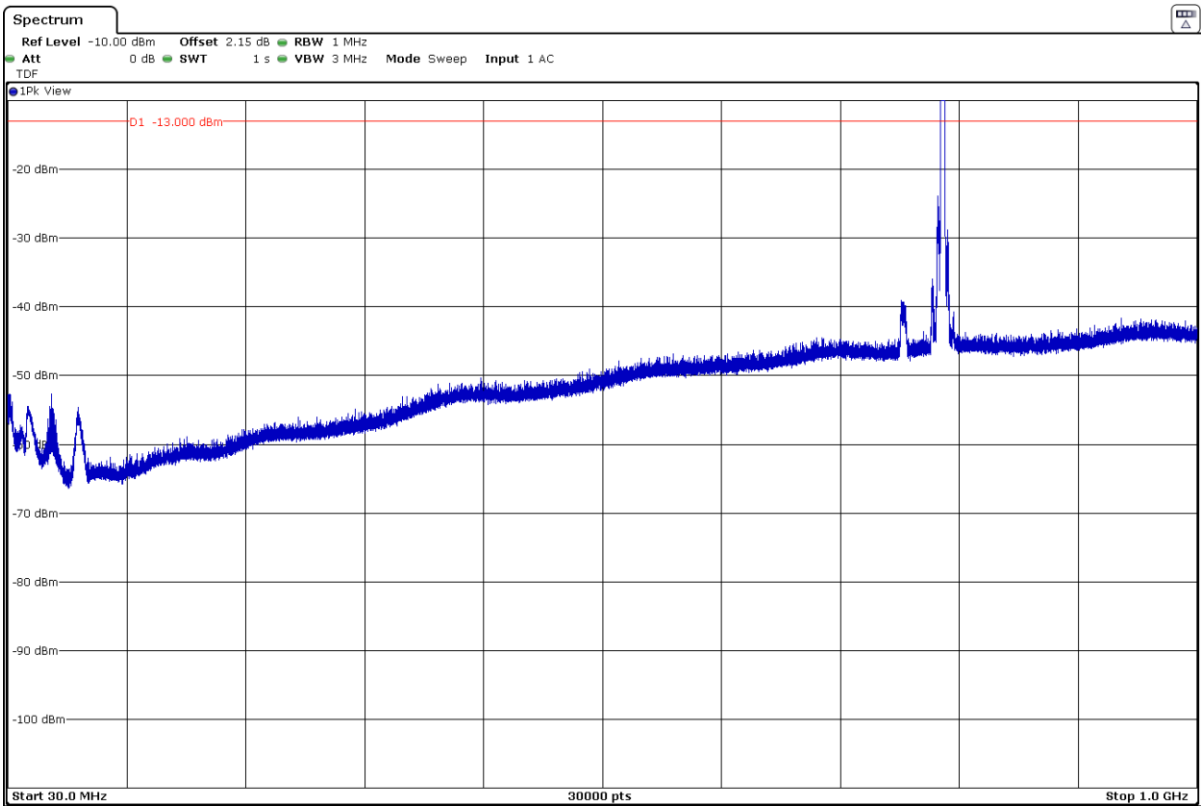
Frequency (MHz)	Instrument reading (dBm)	Polarization	(1) Generator output (dBm)	(2) Cable loss (dB)	(3) Substitution antenna gain Gi (respect to isotropic radiator) (dB)	E.I.R.P. (dBm) = (1) – (2) + (3)
1.5954778	-36.61	V	-49.80	0.80	8.44	-42.16

Measurement uncertainty (dB)	<±3.88 for f < 1GHz <±3.70 for f ≥ 1 GHz up to 8 GHz

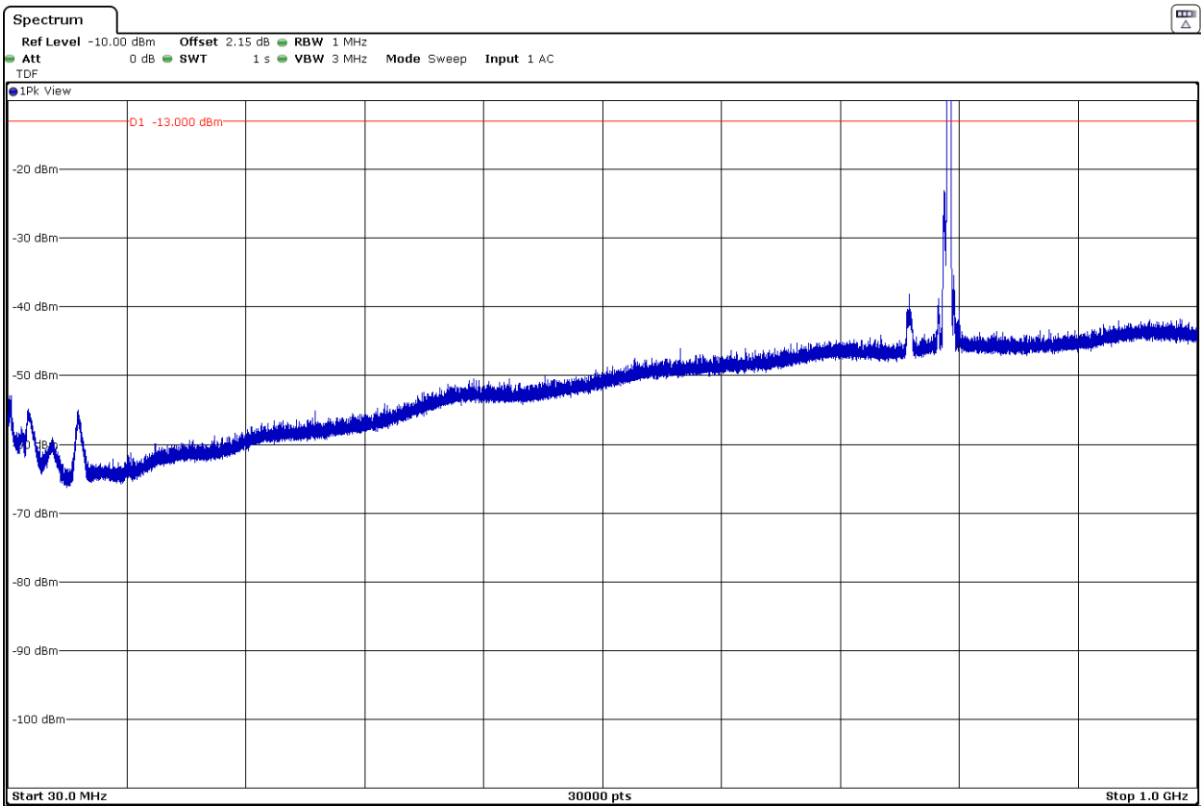
Verdict: PASS

FREQUENCY RANGE 30 MHz - 1 GHz

- Lowest Channel:

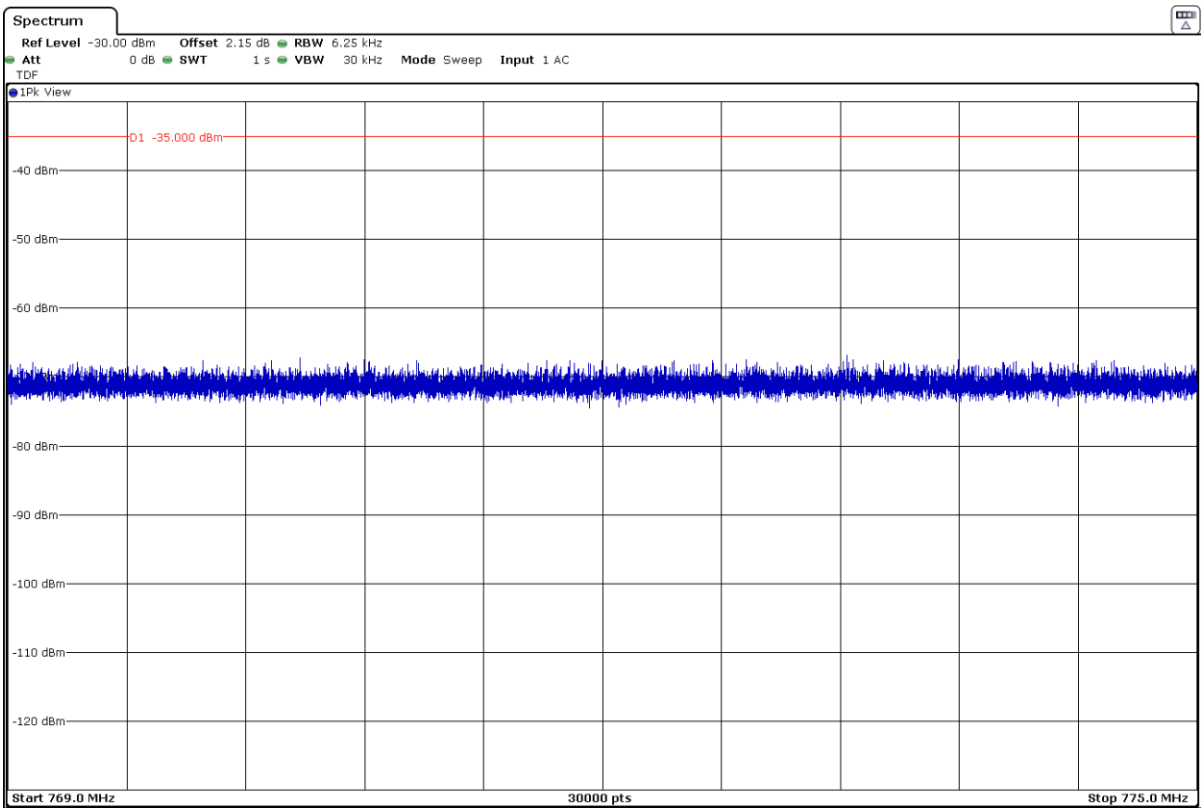


- Highest Channel:

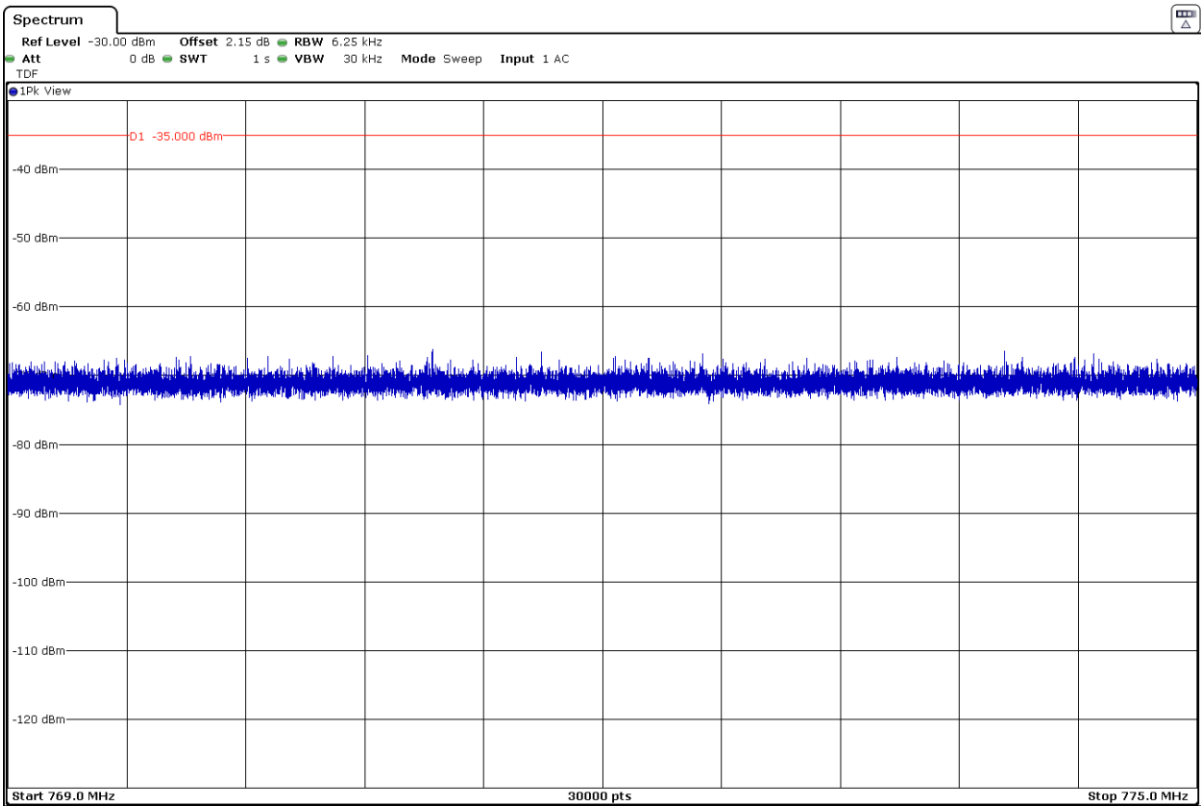


FREQUENCY RANGE 769 - 775 MHz

- Lowest Channel:

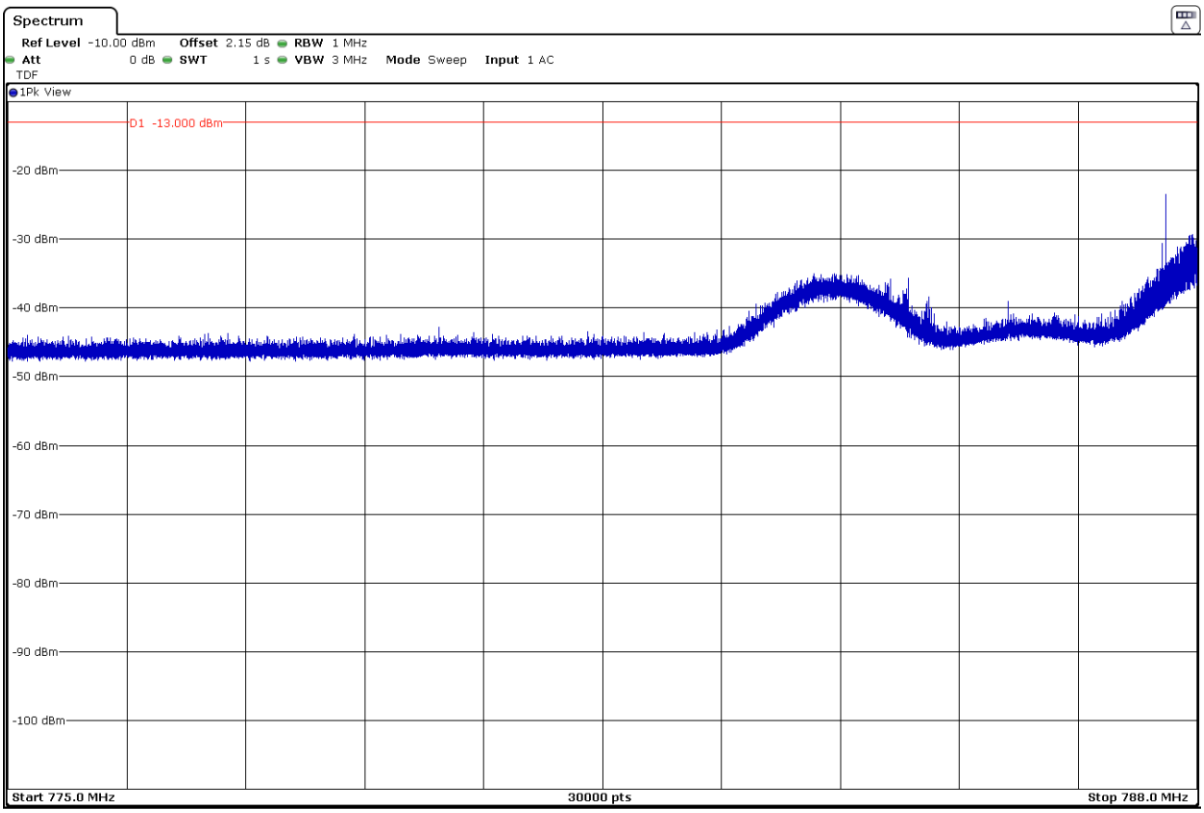


- Highest Channel:

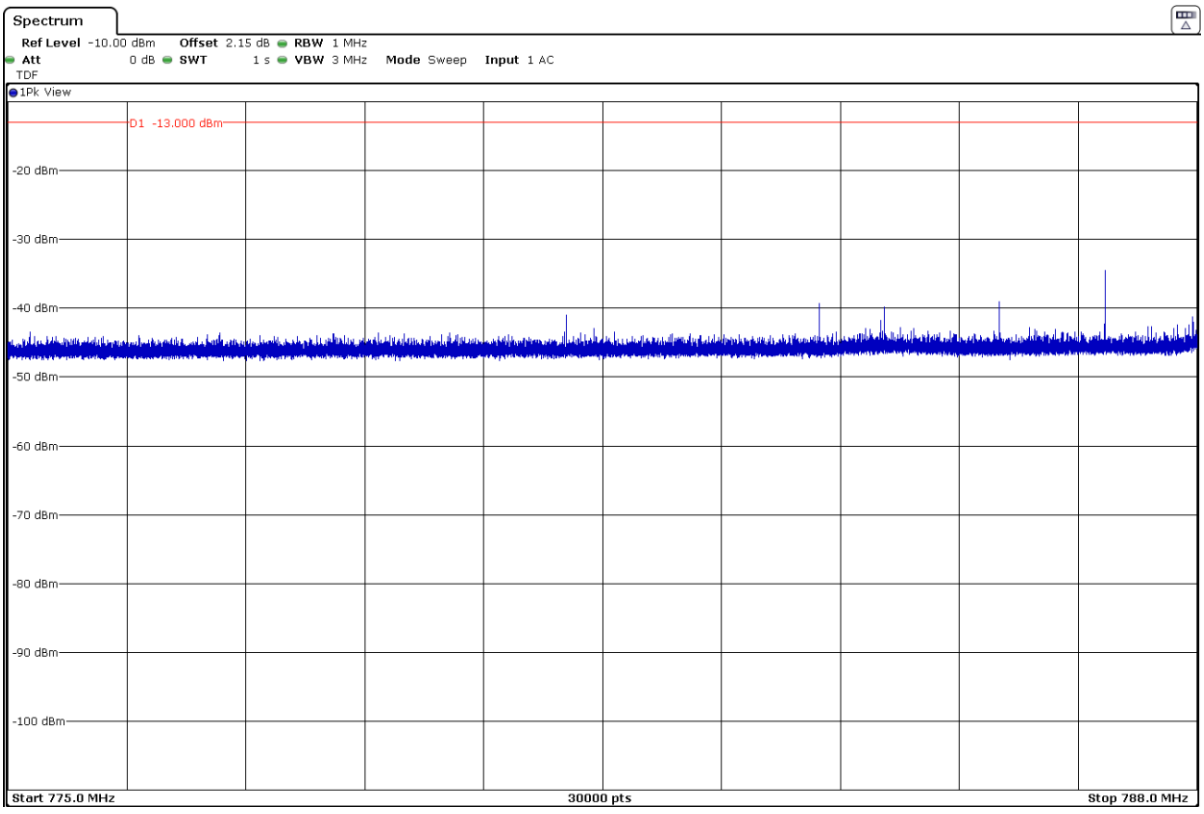


FREQUENCY RANGE 775 - 788 MHz

- Lowest Channel:

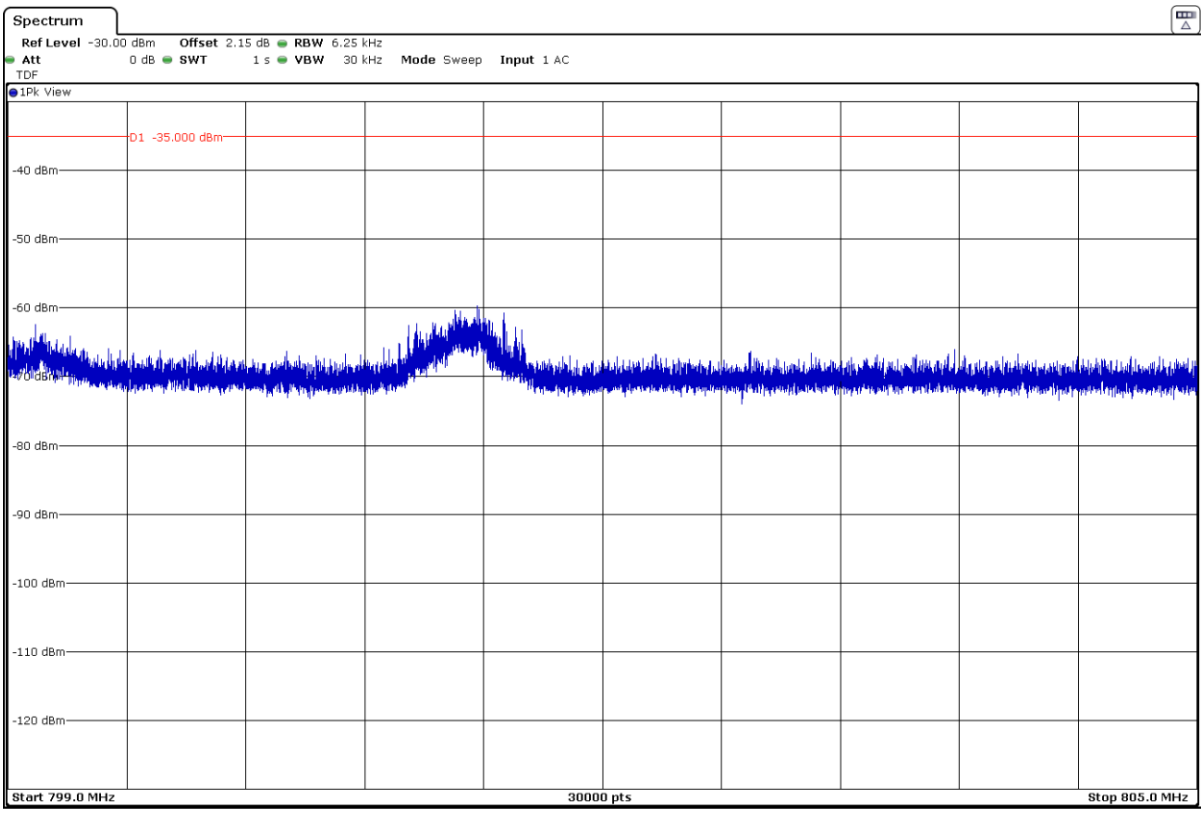


- Highest Channel:

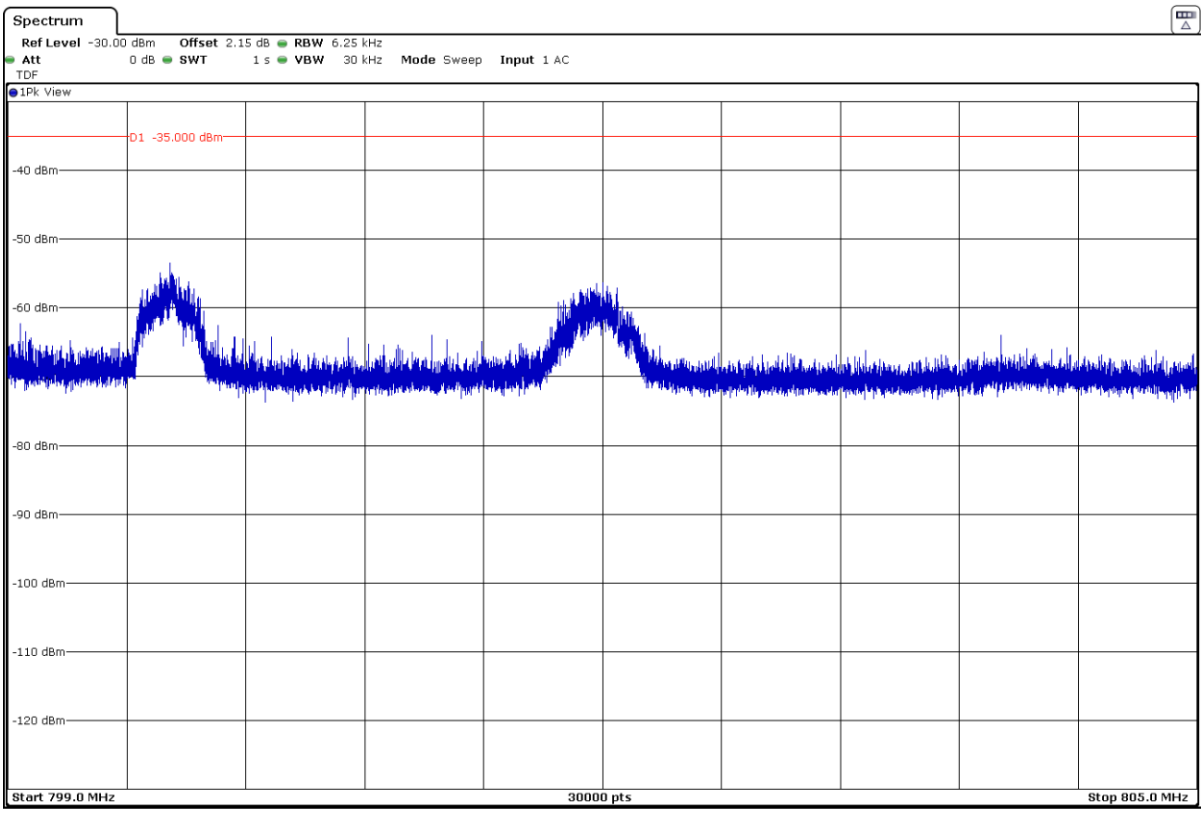


FREQUENCY RANGE 799 - 805 MHz

- Lowest Channel:

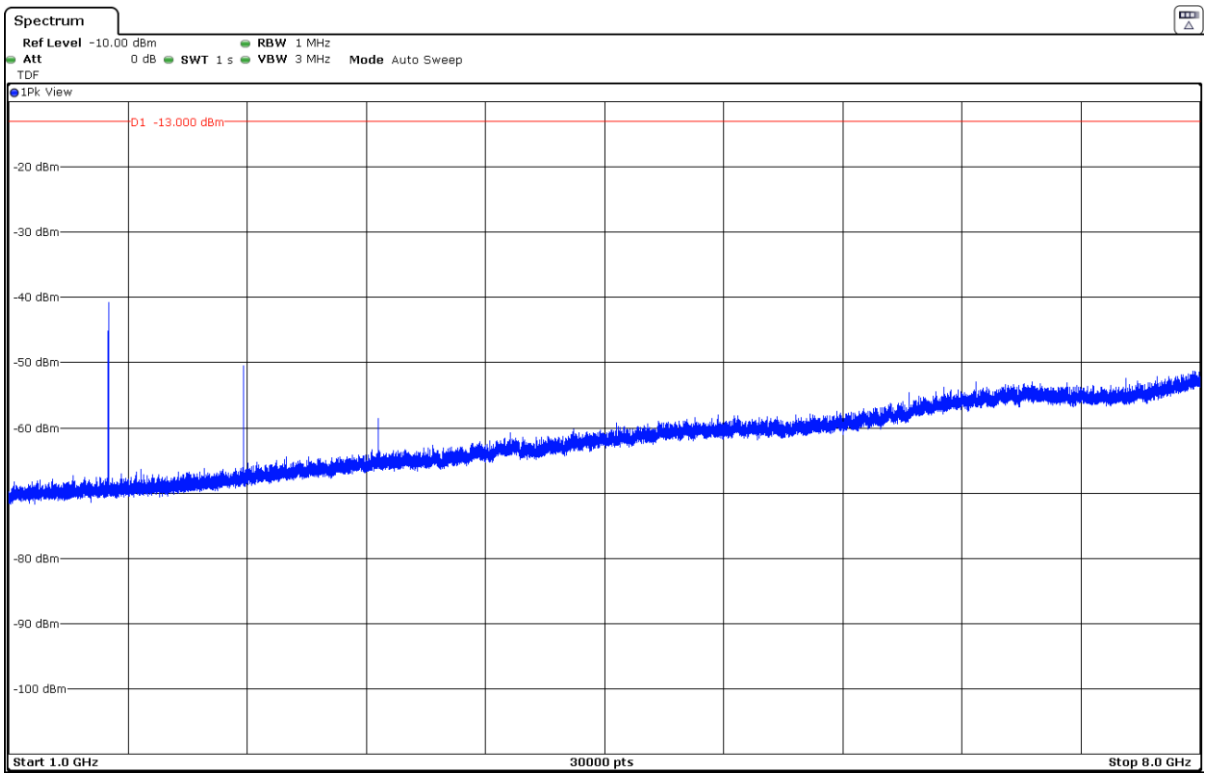


- Highest Channel:

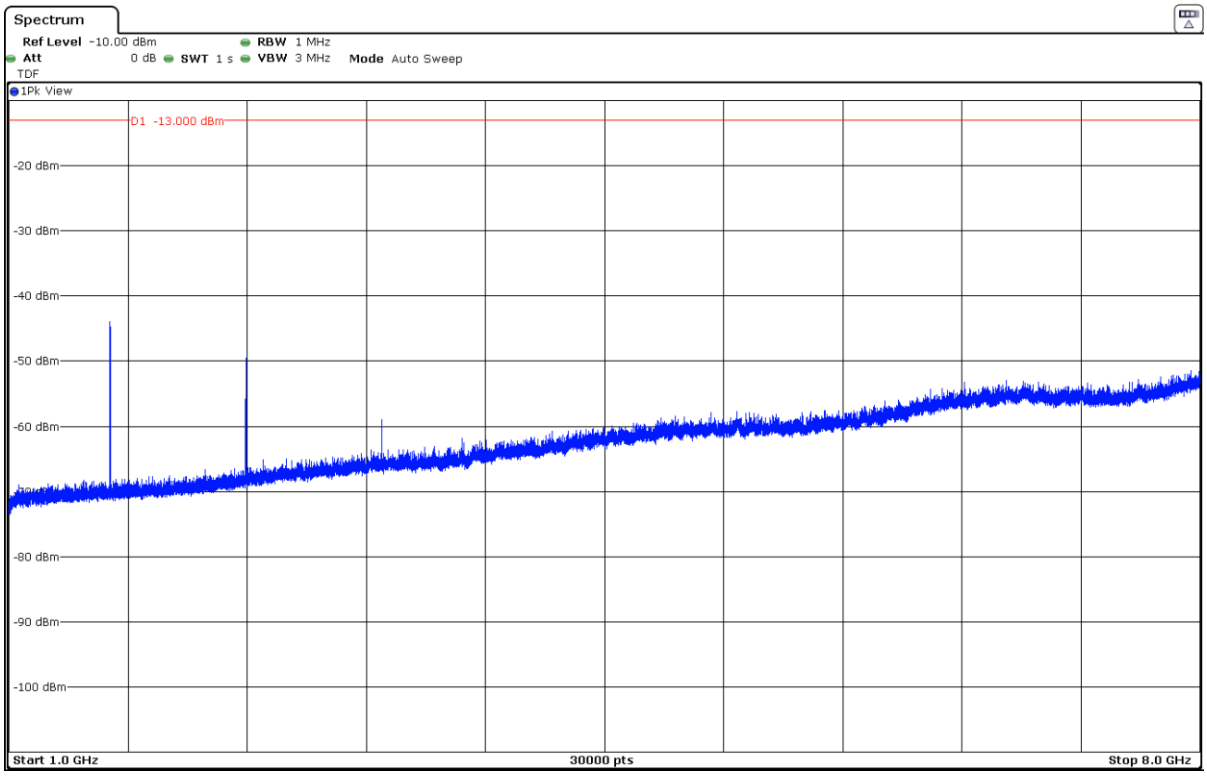


FREQUENCY RANGE 1 - 8 GHz

- Lowest Channel:

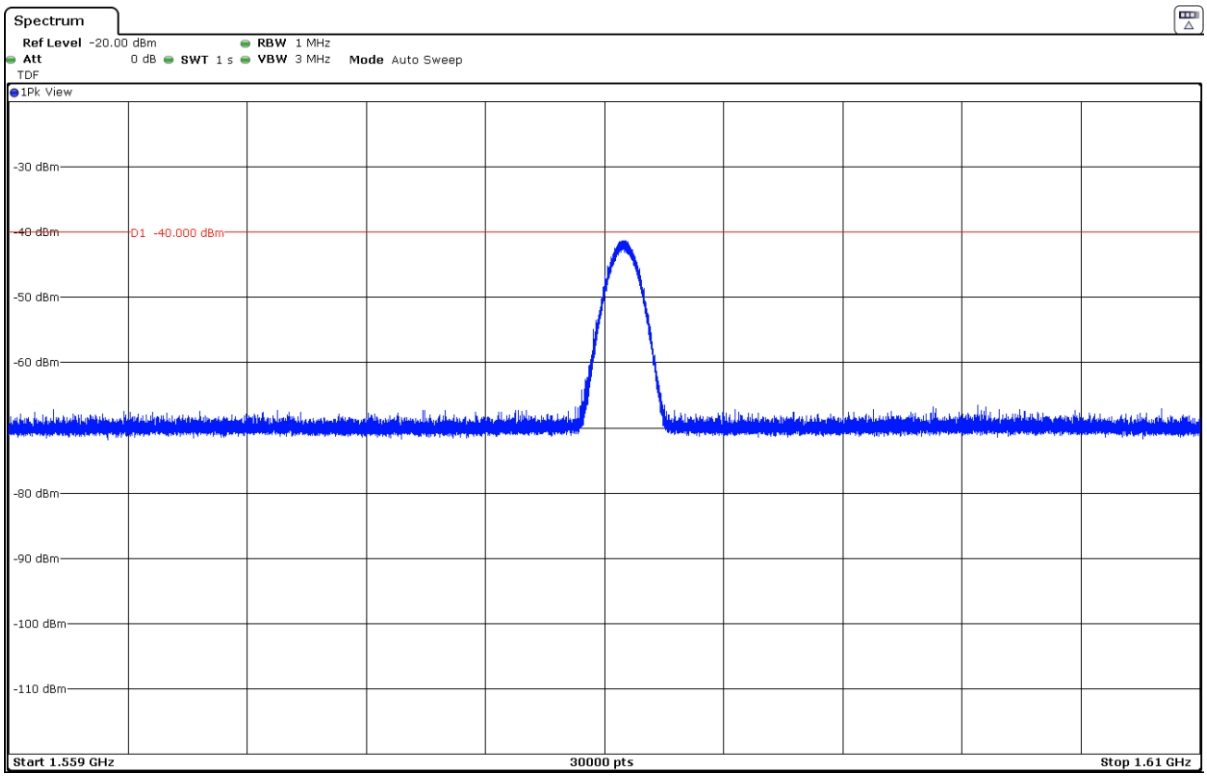


- Highest Channel:



FREQUENCY RANGE 1559 - 1610 MHz

- Lowest Channel:



- Highest Channel: